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RECENT DISASTER IN THE HYPOSTYLE HALL OF KARNAK.—THE FALLEN COLUMNS.

THE DESTRUCTION OF THE HYPOSTYLE HALL IN KARNAK.

IN the SCIENTIFIC AMERICAN SUPPLEMENT for February 25, 1899, appeared an illustrated article on the restoration of the great temple of Karnak, the most imposing sanctuary on the banks of the Nile. The work of restoring the temple to its former splendor was progressing rapidly when an unforeseen event occurred, which threatened the very existence of the structure

A fifty-foot lotus-formed column in the famous hypostyle hall fell, without any warning whatever, against its neighbor, so that nine other columns in the same line were hurled to the ground. Mighty architraves, weighing ten tons, crashed down when the pillars gave way beneath them; and the splendid hypostyle hall was a chaotic mass of debris.

None of the ruined columns had ever given cause for uneasiness. Each was apparently as substantial and sound as when it was first erected, four thousand years ago. The architects of the restoration therefore decided to complete their work in other parts of the temple before proceeding to the hypostyle hall.

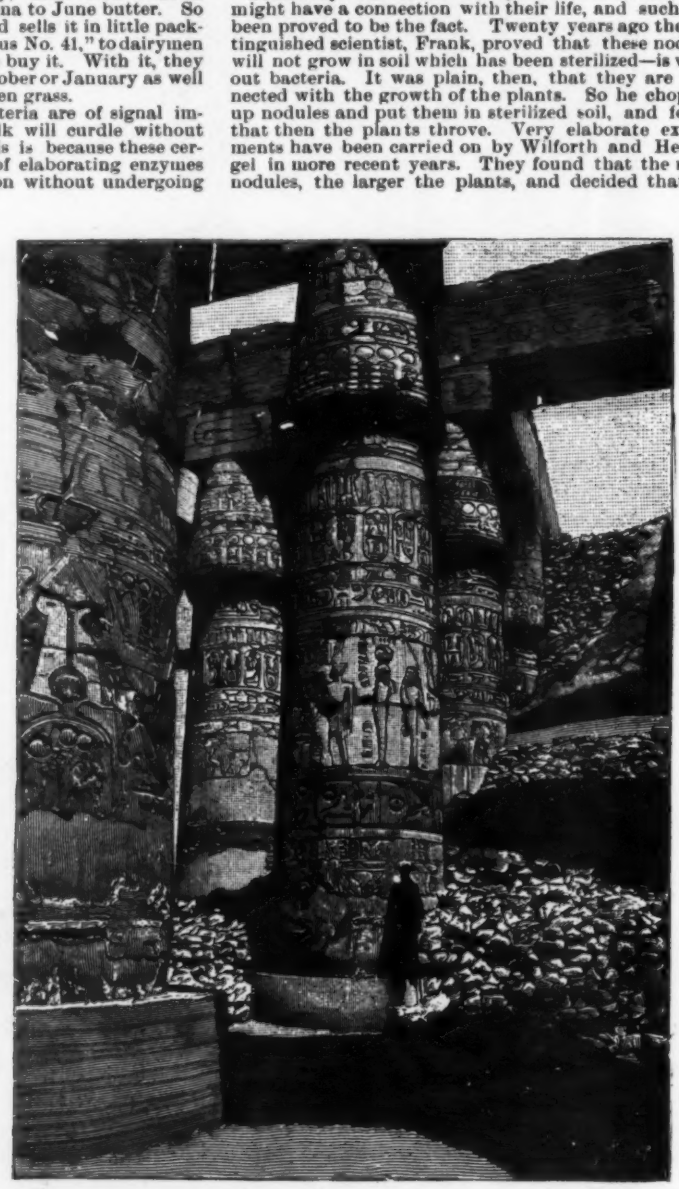
The commission appointed by the Egyptian government to inquire into the catastrophe is of the opinion that an earthquake caused the falling of the columns. It would certainly not be the first time that seismic disturbances have destroyed Egyptian temples; they have played a sinister part in the history of the temple of Amun.

It is said that many structures are endangered by the infiltration of the waters of the Nile, and that the destruction of the hypostyle hall is to be attributed thereto. Whatever may be the cause of the catastrophe, steps should be immediately taken to rebuild the columns and to prevent a recurrence of the accident. The commission has estimated that $20,000 will be required for the work.

It is to be hoped that the Egyptian government will not hesitate in giving the director of antiquities, M. Maspero, the necessary authority to save what is still left of one of the grandest relics of ancient Egyptian glory.

Our illustrations and particulars have been taken from L'Illustration.

RUINED COLUMNS IN THE HYPOSTYLE HALL.



THE SAME COLUMNS BEFORE THE CATASTROPHE.

VALUABLE BACTERIA AND THEIR USES.

By A. DINSMORE.

WE have heard so much about the cholera bacillus, the diphtheria and typhoid bacteria—the hapless microbe in many death-dealing situations—that unless we follow up scientific investigation more closely than most people have time to do, we are in danger of overlooking the fact that hardly any other plants are, on the whole, more useful to man than bacteria. Those who have greatest horror of them, doubtless, are the not inconsiderable number of people who still suppose them to be animals. Let such not hide their heads in mortification, for Pasteur himself was not at first always certain where to classify one of these organisms.

The fact is that bacteria, under some conditions, dart about so much and give so many signs of intelligence, that an observer who forgets that movement is characteristic of plants as truly as of animals might easily mistake them for animals. Their reproduction by means of spores places them clearly among plants. Many students are now engaged in experiments with them in laboratories, where they are isolated, cultivated in grated potato, agar-agar, and other congenial media, kept at proper temperatures, grown in fabulous numbers, and watched under lenses that magnify thousands of diameters.

The following instances of bacterial activity are brought together to show the breadth of range of their usefulness to the farmer, dairyman and tanner directly, and indirectly to the great public who are dependent upon these men for their every-day needs.

Lafar, the Viennese authority on mycology, speaks of the "flora of milk," as indeed it is correct to do, for at least ten species of bacteria living in milk have been discovered. Some of these are objectionable, those incident to a diseased condition of the cow are, of course, and it is on account of danger from this source that so many devices for sterilizing milk are in the market and that it is boiled by careful housekeepers. But they are by no means all injurious. Prof. Conn, of Wesleyan University, discovered that a bacillus gives the fresh-feed aroma to June butter. So now he cultivates this plant and sells it in little packages, under the name of "Bacillus No. 41," to dairymen who are progressive enough to buy it. With it, they can make "June butter" in October or January as well as in the month of roses and green grass.

In the making of cheese, bacteria are of signal importance, for by their use, milk will curdle without souring or adding rennet. This is because these certain bacteria have the power of elaborating enzymes which bring about fermentation without undergoing any chemical change themselves. In other words, these enzymes or ferments of vegetable origin have the same effect upon the milk that the pepsin of the calf's stomach has, and can be used in its place.

Roquefort cheese is given its color by the presence of a bacterium called Penicillium glaucum, obtained in this way: Bread is allowed to be covered with a growth of this plant in the form of what we call mold; it is then dried and ground, and the powder, rich in spores, is strewn in the curd. But the young spores will not grow without air, so fine holes are made with a needle in the curd, and these delicate bacteria, known as "thread fungi," flourish to tickle the palate of the epicure the world around. Edam cheese gets its peculiar quality from a certain fission fungus which infests the leaves of that very interesting species of aquatic plant, the Penguicula. Both the Swiss and Dutch dairymen used to be troubled with what they called "ropy milk." The milk, after standing a while, could be drawn out into threads a yard long. The Swiss tried every means they had to overcome the trouble; they fumigated and scoured and did their best to get rid of cocci bacteria in chains in their milk. The Dutch were wiser; they tried to take advantage of natural curdling to make a special kind of cheese, and this is the famous Edam. If the cows eat the leaves of the Penguicula or the milk pails are rubbed with them, the result is the same; the bacteria which excrete or elaborate the right enzyme are introduced and do the work.

The relation of bacteria to the art of tanning leather is interesting. Tanners have long noticed that the bark liquor used in tanning sours. When the matter was first investigated, it was thought that a new acid had been found, and it was named "acide nancéique" after the town of Nancy, in France, where it was discovered. It was less than ten years ago that it was shown that the sourness is due to two old acids, acetic and lactic, both owing to the numerous bacteria which thrive in the bark mixtures. No less than sixty thousand have been isolated in one milligramme of Silesian oak bark. The thinner leathers are made softer by lying in the acid liquor; and so the tanner puts some of the old liquor into the new he prepares, thus increasing the number of bacilli and thereby improving the quality of his stock.

But what do bacteria offer to the farmer? Much—for they are abundant in soil that is most productive. Their signal service is in the fixation of nitrogen, an element of the highest importance to plants, and not always accessible. It has long been known that when peas, clover, and other leguminous plants were sowed in a soil where no nitrogen compounds are found, they would grow when other things would die. It is not so long since it was noticed that these plants have numbers of little nodules on their roots.

Somebody was clever enough to think that they might have a connection with their life, and such has been proved to be the fact. Twenty years ago the distinguished scientist, Frank, proved that these nodules will not grow in soil which has been sterilized—is without bacteria. It was plain, then, that they are connected with the growth of the plants. So he chopped up nodules and put them in sterilized soil, and found that then the plants throve. Very elaborate experiments have been carried on by Wilforth and Hellriegel in more recent years. They found that the more nodules, the larger the plants, and decided that the absorption of the nitrogen from the air is dependent upon them.

But what are the nodules? Ten years ago it was settled beyond question that they are themselves bacteria, for, taken off the plant, they have been cultivated on plates, sending out two forms of cells in true bacterial fashion.

Hellriegel determined the fact that nodule bacteria taken from peas will not develop nodules on clover, and vice versa; each species of plant has its own bacteria. It has further been discovered that some of the bacteria in nodules in time become modified so that they no longer reproduce, and these apparently store up nitrogen. They are called bacteroids. Just how they accomplish the storage has been the object of careful investigation by Lafar, whose work has been consulted in the preparation of this article, and by other scientists.

A. B. Frank has found that the air passages of the nodules do not extend into the bacterioidal tissue, so that the nitrogen cannot get to them directly from the air. Some investigators think it must be obtained from water which is absorbed by the roots. Two species of fission fungi are known which do absorb nitrogen directly from the air, fix it, and elaborate organic substance from it. They may act as assistants to the nodules. The question seems yet to offer something to students, but it is certain that the nitrogen is fed to the plant by the nodules, and that other kinds of plants unsupplied with these assistants will not live in the same soil.

On the whole, there are few fields of research, if indeed there are any, more rewarding than that offered by the infinitely small, infinitely numerous and one may almost say infinitely powerful, bacteria.

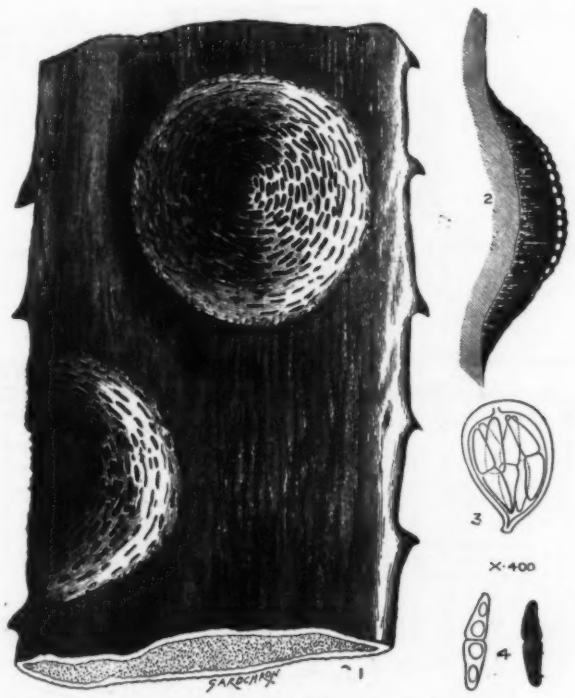
A FUNGUS PARASITE ON ALOE.

A VERY remarkable parasitic fungus has just been forwarded to us, says The Gardeners' Chronicle, for determination. It was communicated by Mr. Thomas Rogers, Manchester, who states that it occurs on the leaves of an Aloe that is common on the hillsides in Cape Colony, South Africa. As only small portions of leaves were received, the host-plant cannot be determined with certainty, although the material at command suggests Aloe platylepis, Baker.

When fully developed, the fungus forms black, convex circular patches, varying from 1 to 1½ inches in diameter. In some instances the fungus occupies a corresponding position on both surfaces of the leaf; in others it is present on one surface only, a corresponding depression forming on the opposite side of the leaf.

The stroma, or fruit-bearing portion of the fungus, first shows on the surface of the leaf at the central portion of the diseased patch, under the form of detached but closely packed black spots, the increase of the patch being due to the continued growth of the black spots grouped in concentric rings round the oldest central portion. The rings spring from the mycelium of the fungus, which radiates in the tissues of the leaf equally on every side from the point of infection. The black patches of the stroma of the parasite are developed below the epidermis of the leaf, which they eventually rupture, and appear on the surface; hence, in a developing patch the central portion is quite black, whereas at the circumference the patch is silvery-white, due to the dead epidermis not yet being ruptured, while between these two points the stroma may be seen just bursting through the epidermis.

This method of extending from a central point in concentric circles is similar in origin to the formation of fairy-rings in pastures by the fairy-ring Mushroom or Chantrelle—Marasmius oreades; only in the latter instance a single ring is formed each season by the extending mycelium present in the soil, and this ring disappears before the formation of the succeeding ring of next season; whereas in the Aloe fungus the rings are persistent, and consequently at maturity the patch consists of a considerable number of crowded concentric rings, the central one of which is the oldest, and the external one the youngest. The external surface of the stroma is minutely warted, each wart covering a cavity containing a cluster of asci, each ascus in turn containing eight spores. A solution of potassium hydrate extracts a deep purple coloring matter from the stroma of the fungus.



FUNGUS PARASITE ON ALOE.

1, portion of an aloe leaf showing two patches of the fungus; 2, section through the fungus; 3, ascus containing spores; 4, free spores.

[Continued from SUPPLEMENT, No. 1251, page 20061.]

VARIATION AND SOME PHENOMENA CONNECTED WITH REPRODUCTION AND SEX.*

SENILE DECAY AND REJUVENESCENCE OF ORGANISMS.

ANOTHER question, also of the utmost importance, confronts us at this point. As is well known, organisms are liable to wear and tear, sooner or later, some part or parts essential to the maintenance of the vital functions wear out and are not renewed by the reparative processes which are supposed to be continually taking place in the organism. This constitutes what we call senile decay, and leads to the death of the organism. As a good example of the kind of cause of senile decay, we may mention the wearing out of the teeth, which in mammals at any rate are not replaced; the wearing out of the elastic tissue of the arterial wall, which is probably not replaced. There is no reason to suppose that the reparative process of any organism is sufficiently complete to prevent senile decay. There is probably always some part or parts which cannot be renewed, even in the simplest organisms. Maupas has shown that this holds for the ciliated Infusoria, and has also shown how the renewal of life, which of course must be effected if the species is to continue, is brought about. He has shown that it is brought about by conjugation, during which process the organism may be said to be put into the melting-pot and reconstituted. For instance, many of the parts of the conjugating individuals are renewed, including the whole nuclear apparatus, which there is every reason to believe is of the greatest importance to living matter.

On reconsidering the life of the Metazoa in light of the facts established by Maupas for the Infusoria, we see that all Metazoa are in a continual state of fission, as are the ciliated Infusoria. They are continually dividing into two unequal parts, one of which we call the parent and the other the gamete. The parent Metazoon must eventually die; it cannot be put into the melting pot; its parts cannot be completely renovated. The gamete can be put into the melting pot of conjugation, and give rise to an entirely reconstituted organism, with all the parts and organs brand new and able to last for a certain time, which is the length of life of the individual of the species.

Is there any other way than that of conjugation by which an organism can acquire a complete renewal of its organs? Is the renewal furnished by the development of all the parts afresh which takes place in a parthenogenetic ovum such a complete renewal? This question cannot now be certainly answered, but the balance of evidence is in favor of a negative answer. And this view of the matter is borne out by a consideration of the facts of the case. In all cases of conjugation which have been thoroughly investigated, the nuclear apparatus is completely renewed. It would appear, indeed, as though the real explanation of the uninuclear character of the Metazoon gamete is to be sought in the necessity of getting the nuclear apparatus into the simplest possible form for renewal. Now in the development of a parthenogenetic ovum the ordinary process of renewal of the nucleus is often in partial abeyance. As a rule, it only divides once instead of twice, and there is, of course, no reinforcement by nuclear fusion. It is, of course, possible that the reinforcement by nuclear fusion which occurs in conjugation may have a different explanation from the nuclear reconstitution which takes place in the formation of polar bodies and similar structures. On the other hand, it may all be part of the same process. We cannot tell. So that we are unable to answer the question whether for complete rejuvenescence a new formation of all parts of the organism is sufficient, or whether a reconstitution of the nuclear apparatus of the kind which takes place in the maturation of the Metazoon ovum and the division of the micro-nucleus of Paramœcium is also required; or, finally, whether in addition to the latter phenomenon a reinforcement and reconstitution by fusing with another nucleus is also necessary for that complete rejuvenescence which enables an organism to begin the life cycle again and to pass through it completely.

With regard to buds in plants, there is reason to believe that they share in the growing old of the parent. That is to say, if we suppose the average life of the individual to be 100 years, a bud removed at 50 will be 50 years of age, and only be able to live on the graft for 50 more years.

HEREDITY.

Having now spoken at some length of the phenomenon of variation, I must proceed to consider from the same general point of view the phenomenon of heredity.

As we have seen, in asexual reproduction heredity appears, as a general rule, if not always, to be complete. The offspring do not merely present resemblances to the parent—they are identical with it. And this fact does not appear to be astonishing when we consider the real nature of the process. Asexual reproduction consists in the separation of a portion of the parent, which like the parent is endowed with the power of growth. In virtue of this property, it will assume, if it does not already possess it, and if the conditions are approximately similar, the exact form of the parent. It is a portion of the parent; it is endowed with the same property of growth; the wonder would be if it assumed any other form than that of the parent. Indeed, it is doubtful if the word heredity would ever have been invented if the only form of increase of organisms was the asexual one, because there being no variation to contrast with it, it would not have struck us as a quality needing a name any more than we have a name for that property of the number two which causes it to make four when duplicated.

The need for the word heredity only becomes apparent when we consider that other form of reproduction in which the real act of reproduction is associated with the act of conjugation. Looking at reproduction from a broad point of view, we may sum up the difference between the two kinds, the sexual and the asexual, by saying that whereas the essence of sexual reproduction is the formation of a new individuality, asexual reproduction merely consists in increasing the number of one kind of individual. From this point of view sexual reproduction is better termed the creation of a new individuality, for that, and not the increase in the number of individuals, is its real result. Inasmuch as conjugation of two organisms is the essential feature of sexual reproduction, it would appear that the number of individuals would be actually diminished as a result of it; and this does really happen, though in a masked manner, for we are not in the habit of looking upon the spermatozoon and ovum as individuals, though it is absurd not to do so, as they contain latent all the properties of the species, and are sometimes able to manifest these properties (parthenogenetic ova) without conjugating. In some of the lower organisms the fact that conjugation does not result in an increase of the number of individuals, but only in the production of a new individuality, is quite apparent, for in them two of the ordinary individuals of the species fuse to form one (many Protozoa).

So that sexual reproduction gives us a new individuality which can spread to almost any extent by asexual reproduction. This asexual reproduction gives us a group of organisms which is quite different from a group of organisms produced by sexual reproduction. Whereas the latter groups constitute what we call species, the former group has, so far as I know, no special name, unless it be variety; but variety is not a satisfactory name, for it has been used in another sense by systematizers.

Heredity, then, is really applicable only to the appearance in a zygote of some of the properties of the gametes. A zygote has this property of one of the precedent gametes, and that property of the other, in virtue of the operation of what we call heredity; it has a third property possessed by neither of the precedent gametes in virtue of the action of variation, the nature of which we have already examined. It is impossible to say which property of a gamete will be inherited, and it is impossible to predict what odd property will result from the combination of the properties of the two gametes. Of one thing only are we certain, that they are never the same in zygotes formed by gametes produced in immediate succession from the same parent.

We may thus regard the activities of the zygote as the resultant of the dashing together of the activities of the gametes.

Conjugation, then, is a process of the utmost importance in biology; it provides the mechanism by which organisms are able to vary, independently of the conditions in which they live. It lies, therefore, at the very root of the evolution problem; the power of combining to form a zygote is one of the fundamental properties of living matter.

SPECIES.

Now let us consider one of the effects of this property upon organisms. The effect to which I refer is the division of animals into groups called species. Species are groups of organisms the gametes of which are able to conjugate and produce normal zygotes. Now in nature there appear to be many causes which prevent gametes from conjugating. First and most important of all is some physical incompatibility of the living matter which prevents that harmonious blending of the two gametes which is essential for the formation of a normal zygote. Very little is known as to the real nature of this incompatibility; in fact, it is hardly an exaggeration to say that nothing is known. It may be that there is actual repulsion between the gametes, or it may be, in some cases, at least, that the gametes are able to fuse, but not to undergo that intimate blending which is necessary for the production of a perfect zygote. In some cases we know that something like this happens; for instance, a blend can be obtained between the horse and the ass, but it is not a perfect blend, the product or zygote being imperfect in one most important particular—namely, reproductive power.

A second cause which prevents conjugation is a purely mechanical one, viz., some obstacle which prevents the two gametes from coming together. As an instance of this I may refer to those cases among plants in which conjugation is impossible, because the pollen tube is not long enough to reach the ovule. In yet other cases conjugation is impossible because the organisms are isolated from one another either geographically or in consequence of their habits. There are probably many causes which prevent conjugation, but, whatever they may be, the effect of them is to break up organisms into specific groups, the gametes of which do normally conjugate with one another.

In many cases, no doubt, the gametes of organisms which are kept apart in nature by mechanical barriers will conjugate fully if brought together. But in the great majority of cases it is probable no amount of proximity will bring about complete conjugation. There is physical incompatibility. Here is a fruitful opening for investigation. Observations are urgently needed as to the real nature of this incompatibility.

IMPORTANCE OF THE STUDY OF VARIATION.

Another and most important effect of conjugation is, as we have seen, the much spoken of constitutional or genetic variations. They are, as we have already insisted, of the utmost importance to the evolutionist. Evolution would have been impossible without them, for it is made up of their summation. It becomes, therefore, desirable to find out to what extent a species is capable of varying. This can only be done, as Mr. Bateson has pointed out, by recording all variations

*Opening address by Adam Sedgwick, M.A., F.R.S., President of the Zoological Section, British Association.

found. Mr. Bateson, in his work already referred to, has carried this out, and has shown the way to a collection of these most important data. In order to carry it further, I would suggest that the collection be made, not only for structure, but also for function. This has been done largely for the nervous functions by psychologists and naturalists, who pay special attention to the instincts of animals; but we want a similar collection for other functions. For instance, the variations in the phenomena of heat and menstruation, and of rut among mammals, and so on. To do this is really only to apply the methods of comparative anatomy and comparative physiology to the members of a species, as they have already been applied to the different species and larger groups of the animal kingdom. Such investigations cannot fail to be of the greatest interest. Indeed, when we have learnt the normal habits and structure of a species, what more interesting study can there be than the study of the possibilities of variation contained within it? Then, when we know the limits of variability of any given specific group, we proceed to try if we can by selective breeding or alteration of the conditions of life alter the variability, and perhaps call into existence a kind of variation quite different in character from that previously obtained as characteristic of the species.

THE EVOLUTION OF HEREDITY AND THE ORIGIN OF VARIATION.

These remarks bring me to the consideration of a point to which I am anxious to call your attention, and which is an important aspect of our subject. Has the variability of organisms ever been different from what it is now? Has or has not evolution had its influence upon the property of organisms as it is supposed to have had upon their other properties? There is only one possible answer to this question. Undoubtedly the variability of organisms must have altered with the progress of evolution. It would be absurd to suppose that organisms have remained constant in this respect while they have undergone alteration in all their other properties. If the variability of organisms has altered, it becomes necessary to inquire in what direction has it altered? Has the alteration been one of diminution, or has it been one of increase? Of course, it is possible that there has been no general alteration in extent with the course of evolution, and that the alteration, on the whole, has been one of quality only. But passing over this third possibility, let us consider for a moment which of the two first named alternatives is likely to have occurred.

According to the Darwinian theory of evolution, one of the most important factors in determining the modification of organisms has been natural selection. Selection acts by preserving certain favorable variations, and allowing others less favorable to be killed off in the struggle for existence. It thus will come about that certain variations will be gradually eliminated. Meanwhile the variations of the selected organisms will themselves be submitted to selection, and certain of these will be in their turn eliminated. In this way a group of organisms becomes more and more closely adapted to its surroundings; and unless new variations make their appearance as the old unfavorable ones are eliminated, the variability of the species will diminish as the result of selection. Is it likely that new variations will appear in the manner suggested? To answer this question we must turn to the results obtained by human agency in the selective breeding of animals. The experience of breeders is that continued selection tends to produce a greater and greater purity of stock, characterized by small variability, so that if the selective breeding is carried too far, variation almost entirely ceases, and there is little opportunity left for the exercise of the breeder's art. When this condition has been arrived at, he is obliged, if he wants to produce any further modification of his animals, to introduce new blood—i. e., to bring in an individual which has either been bred to a different standard, or one in which the variability has not been so completely extinguished.

It would thus appear, and I think we are justified in holding this view, at any rate provisionally, that the result of continued selection will be to diminish the variability of a species; and if carried far enough, to produce a race with so little variability, and so closely adapted to its surroundings, that the slightest alteration in the conditions of life will cause extinction.*

If selection tends to diminish the variability of a species, then it clearly follows that as selection has been by hypothesis the most important means of modifying organisms, variation must have been much greater in past times than it is now. In fact, it must have been progressively greater the farther we go back from the present time.

The argument which I have just laid before you points, if carried to its logical conclusion—and I see no reason why it should not be so carried—to the view that at the first origin of life upon the earth the variability of living matter consequent upon the act of conjugation must have been of enormous range; in other words, it points to the view that heredity was a much less important phenomenon than it is at present. Following out the same train of thought, we are inevitably driven to the conclusion that one of the most important results of the evolutionary change has been the gradual increase and perfection of heredity as a function of organisms and a gradual elimination of variability.

This view, if it can be established, is of the utmost importance to our theoretical conception of evolution, because it enables us to bring our requirements as to time within the limits granted by the physicists. If variation was markedly greater in the early periods of the existence of living matter, it is clear that it would have been possible for evolutionary change to have been effected much more rapidly than at present—especially when we remember that the world was then comparatively unoccupied by organisms, and that with the change of conditions consequent on the cooling and differentiation of the earth's surface, new places suitable for organic life were continually being formed. It will be observed that the conclusion we have now reached, viz., that variation was much greater near the dawn of life than it is now, and heredity a correspondingly less important phenomenon, is a deduction from the selection theory. It becomes, therefore, of some interest to inquire whether a suggestion obtained by a perfectly legitimate mode of reasoning receives any independent confirmation from other sources. The first source of facts to which we turn for such confirmation must obviously be palæontology. But palæontology unfortunately affords us no help. The facts of this science are too meager to be of any use. Indeed, they are wanting altogether for the period which most immediately concerns us—namely, the period when the existing forms of life were established. This took place in the prefossiliferous period, for in the earliest fossiliferous rocks examples of almost all existing groups of animals are met with.

But although palæontology affords us no assistance, there is one class of facts which, when closely scrutinized, do lend some countenance to the view that when evolutionary change was of its greatest activity, i. e., when the existing forms of life were being established, variation was considerably greater than it is at the present day.

But as this address has already exceeded all reasonable limits, and as the question which we are now approaching is one of very great complexity and difficulty, I am reluctantly compelled to defer the full consideration and treatment of it to another occasion. I can only hope that the far-reaching importance of my subject and the interest of it may to some extent atone for the great length which this address has attained.

APPENDIX.

The following observations on the condition of the male reproductive organs in highly variable plants are quoted from Darwin's "Variation of Animals and Plants under Domestication," vol. ii., p. 256 et seq.

In certain plant hybrids which are highly variable, it is known that the anthers contain many irregular pollen grains. Exactly the same fact has been noticed by Max Wichura in many of our highly cultivated plants which are extremely variable, and which there is no reason to believe have been hybridized, such as the hyacinth, tulip, snapdragon, potato, cauliflower, etc.

The same observer also "finds in certain wild forms the same coincidence between the state of the pollen and a high degree of variability, as in many species of Rubus; but in R. caesius and idaeus, which are not highly variable species, the pollen is sound." A little further on Darwin says, "These facts indicate that there is some relation between the state of the reproductive organs and a tendency to variability; but we must not conclude that the relation is strict." Finally he sums up the matter in these words: "On the whole, it is probable that any cause affecting the organs of reproduction would likewise affect their product—that is, the offspring thus generated."

* The expression extinction of species seems to be used in two senses which are generally confused. First, a species may become modified so that the form with which we are familiar gradually gives place to one or more forms which have been gradually produced by its modification. That is to say, a character or series of characters becomes gradually modified or lost in successive generations. This is not really extinction, but development. Secondly, a species may gradually lose its variability, and become fixed in character. If the conditions then change, it is unable to adapt itself to them, and becomes truly extinct. In this case it leaves no descendants. We have to do with death, and not with development.

SCHOOL FOR MERCHANT MARINE IN RUSSIA.

Thomas E. Heenan, United States consul at Odessa, Russia, writes:

I transmit a translation of the regulations, established by imperial authority, for the management of an institution recently organized in this city, which has for its object the training of young men in the theory and practice of navigation, in order that they may become competent to take command as masters and mates on Russian merchant vessels.

The studies make of those who successfully pass the course highly educated men, familiar with the English, French or German language, physics, mathematics, theoretical mechanics, commerce, political economy, bookkeeping, physical geography, nautical astronomy, shipbuilding, commercial geography, law, hygiene, etc.

I have thought it advisable to bring the knowledge of this establishment to the attention of the Department at this particular time for the reason that it would, in my opinion, be highly advantageous to our future commercial and merchant-marine interests if similar institutions could be successfully established throughout the United States, either in connection with educational institutions or as separate establishments.

As we shall furnish the world with food and manufactured goods, both patriotism and profit demand that these products be carried in American ships, and that these ships be manned and officered by competent Americans.

We move quickly in the United States, and it requires but a slight knowledge of our people to predict that in ten years' time we shall have the largest merchant fleet afloat.

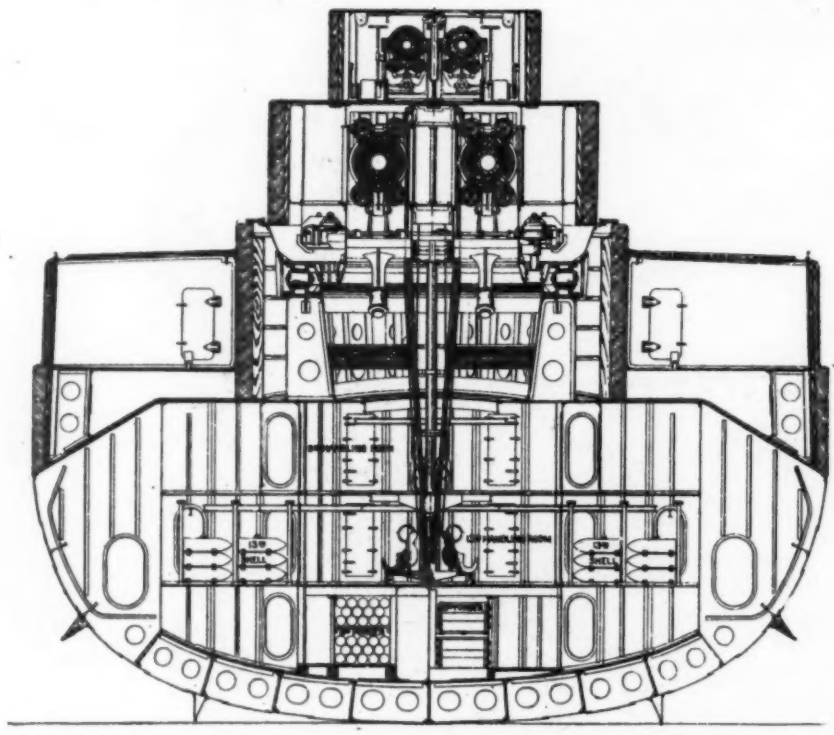
I have been told by Americans who have traveled much in European and Asiatic waters that an American ship is rarely met with, and certainly my own experience as consul at Odessa during the past thirteen years confirms the statement. I have never on a single occasion seen an American ship in the Odessa harbor, and yet, during the year 1897, the official returns show that 1,192 steamers and 34 sailing vessels, having an aggregate tonnage of 1,761,339 registered tons, entered this harbor. Of these, 663 steamers, having a registered tonnage of 1,050,028 tons, were British.

Under the circumstances, it is not suprising that the Russian government is now admitting ships for the Russian foreign and domestic trade free of duty, and is also establishing and endowing marine schools for its coming merchant-marine officers.

THE ELECTRIC PLANTS OF THE BATTLESHIPS "KEARSARGE" AND "KENTUCKY."*

By Naval Constructor J. J. Woodward, U. S. N., Member.

The battleships "Kearsarge" and "Kentucky" are the first vessels of the United States navy on which the use of electricity as a motive power for the ship's auxiliary machinery has been adopted to the practical exclusion of steam. And even in the case of these vessels a distinction has to be made between the auxiliary machinery for the general service of the vessel, such as deck winches, boat cranes, ship's ventilating fans, ammunition hoists, and turret-turning machinery, all of which are operated by electric motors, and the auxiliary machinery connected with the main propelling engines, such as air, feed and circulating pumps, forced-draft blowers, ash hoists, etc., which on these ships are still driven by small steam engines. Further exceptions to the complete use of electricity for the ship's auxiliary machinery are the windlass and steering engines, which are also driven by steam.



TRANSVERSE SECTION THROUGH SUPERPOSED TURRETS.

The electric plants of the "Kearsarge" and "Kentucky" can, therefore, be regarded only as an intermediate step between the complete steam drive for auxiliary machinery, so largely used in the past, and the practically complete electric drive for all auxiliary machinery of every kind whatsoever, whose adoption appears to be a possibility of the near future. Indeed, the most serious present limitation to the extent to which the electric drive for auxiliary machinery may be adopted for service in warships is the time necessary for the officers of the naval service charged with the care of such plants to organize and train the necessary personnel for the care of the dynamos and motors, and to gain that confidence in their power to maintain the plant in a constantly efficient condition which is necessary to overcome the sense of conservative distrust so apt to be felt in a new appliance or method adopted for service on board ship.

For, more than any other branch of engineering work, it is important that power appliances placed on board ship, and especially on men-of-war, shall be capable not only of working satisfactorily when in-

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stalled, but that their maintenance in an efficient condition can be readily accomplished by the ship's force available for the purpose.

While a more extended use has been made of electrically driven auxiliaries on the "Kearsarge" and the "Kentucky" than on any other vessels of the navy up to the present time, attention should be called to the fact that the various types of electrically driven auxiliary machinery used on these vessels are the logical developments of generally similar types previously installed by the Bureau of Construction and Repair on other vessels of the navy. Thus, for example, the turret-turning machinery may be considered a development of that which worked in so satisfactory a manner on the "Brooklyn's" 8-inch gun turrets during the late war with Spain; the chain ammunition hoists are the same in general principle as those used on the "Puritan" and many other vessels; and the extensive systems of blowers and exhausters used in the ship's ventilation are similar in character to those placed on the gunboats "Nashville" and "Wilmington" two years ago, and which to-day are giving eminently satisfactory results, both from the point of view of thorough ventilation of these vessels and ease of maintenance of the ventilation plant in an efficient condition.

SCOPE OF WORK PERFORMED.

Briefly stated, the electric plants of the "Kearsarge" and the "Kentucky" perform the following duties:

1. The ship is lighted under peace and battle conditions.
2. Four search lights are operated.
3. The Ardois signal set is operated for night signaling; also, various means of interior communication within the ship, such as battle and range order indicators, electric propelling and steering engine telegraphs, revolution and helm-angle indicators, etc.
4. The truck lights and ship's running lights are operated, also portable diving lanterns.
5. The two turrets containing the 8-inch and 13-inch guns are rotated, the 13-inch guns elevated, ammunition hoisted for both 8-inch and 13-inch guns, rammers of 13-inch guns operated, and special ventilation provided to blow gases out of bore of 8-inch and 13-inch guns.
6. Ten endless chain ammunition hoists are operated, eight of them supplying the 5-inch broadside guns, and two supplying 6-pounder and 1-pounder guns on upper deck. Two winch types of hoists are operated, supplying ammunition to the 6-pounder guns in the after cabins.
7. Six deck winches are operated; four winches of a simple geared type with friction drum suitable for quick hoists of moderate loads as in coaling ship, and two winches of a compound geared type permitting either the quick hoisting of light loads or heavy pulls at low speeds. The simple geared winches are especially designed for use as ammunition hoists to the military tops.
8. Four boat cranes are operated, the boats being hoisted and lowered, and cranes rotated by power.
9. The ship is ventilated throughout, including the engine rooms, but excluding the fire rooms, by thirteen ventilating fans, of which ten supply and three exhaust air for the various watertight compartments.
10. The centering device on the hydraulic telemotor used to control the steam distribution valve of the steering engine as automatically operated.

DESCRIPTION OF THE SYSTEM OF DISTRIBUTION OF CURRENT.

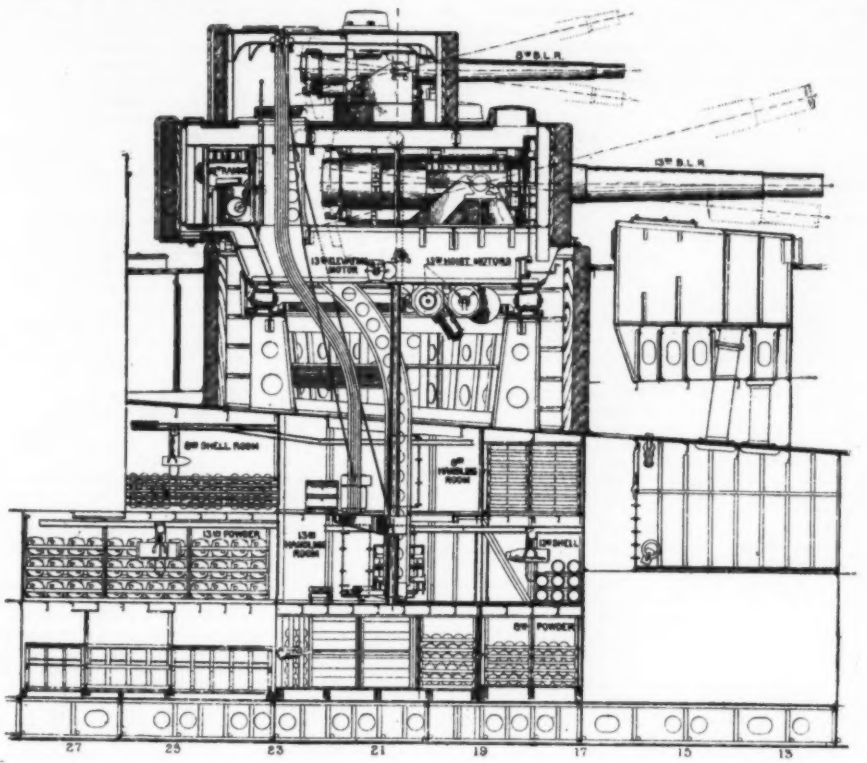
The method of distributing electric energy upon the "Kearsarge" and the "Kentucky" is known as the Edison three-wire system. The object of this system is to allow the use of two pressures—eighty and one hundred and sixty volts; the current required to deliver the same power being one-half as much on the latter as on the former voltage. This permits a material reduction in weight of wiring, switches, etc. It also allows much greater speed regulation of the motors, the half voltage giving at once a speed of one-half the full speed.

The wires used for distributing on the three-wire system can be so connected as to operate any motor upon the ordinary two-wire system, but at a reduction of one-half of its capacity.

Description of Dynamo Room.—The generating plant is located between the inner wing bulkheads, frame 38½ to 41½, occupying all the space below the protective deck.

This space has a platform midway of its height, and the lower half is divided into two compartments by the centerline bulkhead and the passage between the fire-rooms. The upper room contains three generating sets and the switchboards, and each of the lower rooms two sets.

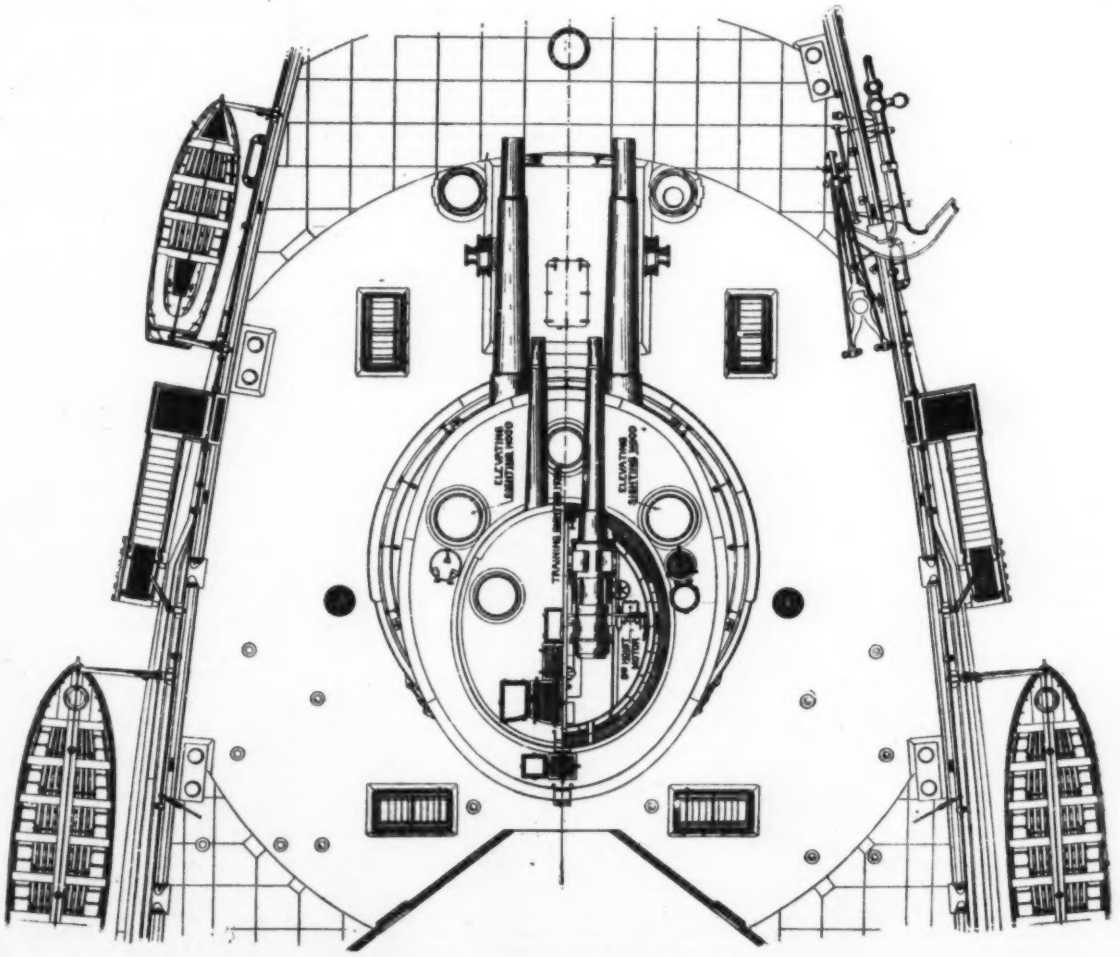
There are seven six-pole fifty-kilowatt eighty-volt compound-wound generators, each driven by a tandem vertical compound engine running 310 revolutions per minute at 100 pounds steam pressure.



LONGITUDINAL SECTION THROUGH FORWARD SUPERPOSED TURRETS OF THE "KEARSARGE."

GENERAL DESCRIPTION OF MACHINES EMPLOYED.

DESCRIPTION OF GENERATING SETS.—Engine.—The engine is of the single crank, vertical, tandem, compound, double-acting, inclosed type, and has a speed of 310 revolutions per minute at full load, with 100 pounds steam pressure, and 25 inches vacuum ex-



DECK PLAN OF "KEARSARGE," SHOWING FORWARD SUPERPOSED TURRETS.

haust. There is a heavy bed plate bolted to the foundation supporting the engine and generator, and part of this bed plate forms a reservoir for the oil used for lubricating the moving parts of the engine. The crank pit, which is inclosed by the column, is accessible through a large door in front of the engine, and a smaller one at the back.

Steam Pressure.—The range of steam pressure for this engine is between 80 and 120 pounds, but the normal as well as the most economical pressure is 120 pounds, and it is advisable to maintain this pressure.

The lowest pressure at which this engine will carry full load is 80 pounds, with 25 inches vacuum. The engine will carry an overload of 50 per cent., and may be run on a steam pressure up to 150 pounds without any trouble.

TURRET TURNING SYSTEM AND APPARATUS.—Motors and Gearing.—There is one fifty-horse-power motor, with the armature and field each wound for eighty volts, located on each side of the 13-inch turret below the floor. They revolve in the same direction, both driving through bevel gears to one shaft which runs across the turret. This shaft carries at one end a right-hand and at the other a left-hand worm, each of which engages with a worm wheel at the top end of a vertical shaft. At the lower end of the vertical shaft of each of the worm wheels is a pinion which meshes with the circular rack inside of the barbette, thus driving the turret.

The worm wheels are connected to vertical shafts by friction clutches, which can be adjusted by nuts above to carry the desired load, but to slip if it be exceeded in order to prevent damage to the driving mechanism due to an excessive overload such as would occur when firing one gun, or possibly in the case of impact of a shell on the outside, tending to produce rotation independently of the motors.

These friction clutches consist of a cone, loosely keyed to the vertical shaft so as to allow movement along it, which is forced against a conical seat in the worm wheel by twelve helical compression springs. These springs are held in a casting keyed to the vertical shaft in the same manner as the cone. The pressure of these springs is adjusted by sliding this casting along the shaft by means of a large recessed nut and check nut at the top end.

The cone can be raised clear of its seat in the worm wheel, without disturbing the adjustment of the compression springs, by screwing down the nuts on twelve studs which are fastened to the cone and pass up through the center of the springs and casting, holding the u.

The object of the cross-shaft is to allow one motor to revolve the turret by driving both pinions should the second motor be mechanically disconnected, and also to permit one motor to revolve the armature of the other motor, in case the latter should fail electrically, through the bevel gears instead of through the worm wheel and worm, which would be the case if the cross-shaft were not employed.

The worms are made right and left, so that the thrust of one shall be balanced by that of the other and relieve the thrust bearing, which is between the guns near the middle of the shaft.

The brushes of the motor are on four studs supported by a yoke which revolves concentric with the shaft. These brushes can be reached through hand holes in the top and end of the frame.

Controller, Switches, and Instruments.—The controller is located on a platform between the 13-inch guns, under the sighting hood. It consists of a cylinder carrying a set of contacts for producing the desired combinations to give the proper speed and direction of rotation to the armatures.

DESCRIPTION OF BOAT CRANES.—Forward Boat Crane.—There are two forward boat cranes located at frame 35, starboard and port, having a capacity of 18,000 pounds at a speed of 25 feet per minute. Each crane has the form of a large boat davit, and is built of structural steel having a box section.

The lower end has a pivot steady bearing on the protective deck, the weight of the crane and its load being taken by a roller thrust bearing on the main deck, and its alignment being preserved by two steady bearings, one on the upper deck and the other on top of the hammock berthing.

Just above the hammock berthing the crane carries a circular platform on which is mounted all the operating machinery, the motive power being furnished by a 50 horse power electric motor. The pinion of the motor meshes with a large gear on one end of a horizontal cross-shaft carried by bearings mounted on the platform; the other end of this shaft carries a worm, working a worm wheel on the upper end of a vertical shaft pressing down through the platform, and carrying at its lower end a pinion meshing in a circular rack having its center in the center line of the crane, and held by the frame of the steady bearing on top of the hammock berthing. This arrangement allows the motor to rotate the crane.

There is a second horizontal cross-shaft on the platform at right angles to the one that rotates the crane, and geared to it by a pair of miter gears near the motor end. This shaft carries a worm working a wheel on the hoisting drum, which is supported by pedestals mounted on the platform.

Each of these horizontal cross-shafts, the one for rotating the crane and the one working the hoisting drum, is divided by a friction clutch near the worm end. The disk of the friction clutch on the shaft that rotates the crane forms the pulley for a friction band brake used for braking the crane when rotating. The hoisting drum is provided with a brake consisting of a tapered wrought-iron band wrapped around a flat portion of the drum, the large end of the band being fastened to the platform and the small end being pulled taut by a weighted lever. The band is wound around the drum in the direction the drum turns when lowering; this effectually locks the drum against lowering as long as the band is pulled taut by the weighted lever, but allows it to turn in the hoisting direction with only a small amount of friction. When it is desired to lower, the band must be slackened by raising the weighted lever, which is accomplished by means of a hand lever.

The two friction clutches and the friction hand brake for rotating are all operated by hand levers, which together with the hand lever for releasing the hoisting brake are all located side by side near the controller for the motor, so that the person operating the crane can easily reach them all.

DESCRIPTION OF AMMUNITION HOISTS.—13-Inch Ammunition Hoists.—One 20 horse power, 160-volt motor is located under the central girder of the turret for the operation of each of the 13-inch hoists, being supported by the bottom plate of the turret.

A drum on the intermediate shaft operates the ammunition car by a flexible steel rope, passing over leading sheaves. The car travels on girder rails.

Description of Motor.—The motors are of the armored type. They have four poles, are shunt wound with fields excited at 80 volts, and give an output of 20 horse power at 160 volts, with an armature speed of 350 revolutions per minute.

8-Inch Ammunition Hoist.—One 6 horse power, 160-volt motor is located outboard of each 8-inch gun, on the gun floor under the sighting hoods, for the operation of the 8-inch ammunition hoist.

A shaft extends across the turret from one motor to the other, which is divided into four sections, the two outboard ones being carried by bearings cast on the motor frames and forming intermediate shafts for the motors, the two middle ones being carried by bearings formed in the deck lugs of the 8-inch guns.

The two outboard or end sections are coupled to the middle sections by means of cylindrical shaft couplers, which are keyed to the end sections and fastened to the middle sections by set screws. The two middle sections are both keyed in a cylindrical shaft coupler at the center, thus acting as one shaft.

Each end section carries at its inboard end a gear meshing with a pinion at the armature shaft; and at its outboard end a drum which operates the ammunition car by a flexible steel rope passing over leading sheaves.

The drum is attached to the shaft by a clutch operated by a hand lever, so that it may either run loose or turn with the shaft, as desired. It also has a band brake operated by a hand lever.

For ordinary operation the end sections of the cross-shaft will be disconnected from the central portion by means of the set screws in the shaft couplings, so that each motor operates its hoist independently, and the load is hoisted and lowered by starting and reversing the motor by means of the controller, the drum being held tight on the shaft by its clutch, and the band brake not used.

If, however, one of the motors should be made inoperative, both hoists can still be worked by connecting in the central portion of the cross-shaft by means of the set screws in the shaft couplers at its ends, thus making the cross-shaft act as one solid piece and allowing both drums to be operated by the uninjured motor.

6-Pounder Winch Hoists.—There are two 6 pounder winch ammunition hoists located at frame 74, just aft of the after barbette on the berth deck, starboard and port.

Description.—Each hoist consists of a cast iron bed plate, on top of which is bolted an armored motor, and underneath the motor is located the resistance box. The bottom of the bed plate is extended, and the operating controller bolted to this extension. The shaft for the drum is supported on brackets or bearings, which are part of the motor casing. Motion is communicated from the armature of the motor to the drum shaft by means of a cut cast steel pinion, having 14 teeth, meshing into a cut cast steel gear having 66 teeth, and secured in an oil-tight covering. On one end of this shaft is keyed the drum, which is 12 inches in diameter and has a 7-inch face. On the inner end of this drum is cast a brake flange. The brake consists of a steel band, to which is bolted vulcanite fiber; one end of the brake band is secured by means of an adjustable bolt to the bed plate of the hoist, and the other end is secured by a bolt to the operating lever, and an adjustable weight is provided at the outer end of this foot lever.

The winch can hoist 120 pounds at the maximum rate of 250 feet per minute.

CHAIN AMMUNITION HOISTS.—There are ten endless chain ammunition hoists, located as follows:

Two for 5-inch ammunition from the magazines on the platform deck at frame 28, starboard and port, delivering upon the gun deck.

Two 5-inch hoists from the ammunition passage on the splinter deck at frame 37, starboard and port, delivering upon the gun deck.

Two 1 and 6-pounder hoists from the ammunition passage, delivering to the upper deck at frame 43, starboard and port.

Two 5-inch hoists from the ammunition passage at frame 53½, starboard and port, delivering upon the gun deck.

Two 5-inch hoists from the platform deck at frame 64, starboard and port, delivering upon the gun deck.

Description.—Each hoist consists of a pair of endless chains, traveling over sprocket wheels, and reaching from the point of loading to that of delivery. These chains support between them carriages placed at proper intervals for receiving the ammunition, the whole being driven by an electric motor through a system of gearing.

The intermediate shaft of the motor is geared to a counter-shaft of the hoist, which has a pinion on the other end engaging a gear on a shaft carrying two sprocket wheels. Two endless chains pass over these sprockets and run up to two similar sprockets in a casting set in the deck at the point of delivery. These endless chains are connected at equal intervals by carriages on which the ammunition boxes are placed. The two bearings of the shaft for the lower sprockets can be moved through an arc of a circle having its center at the center of the counter-shaft which is geared to the sprocket shaft. This permits the distance between the upper and lower sprockets to be adjusted to compensate for stretch and wear of the chain. The adjustment is made by means of two adjusting screws, with lock nuts, which push the bearings down. When the adjustment is made, the bearings are held in place by a set screw.

In order to prevent the load from overhauling and running the hoist backward in case the driving mechanism should fail, pawls are provided which allow the carriages to pass up, but will catch and hold them if they move down. When it is desired to lower ammunition, these pawls must be thrown out of action by means of a lever at the side of the hoist. This lever moves a sliding rod which raises the pawls and turns them back into pockets so that the carriages can descend without engaging them. When the lever handle is up the pawls are in action, and when it is down they are out of action. This lever carries a pawl switch, described later in the motor description.

A hand gear is provided in order that the hoist may still be operated if for any cause the driving motor fails. It consists of two hand cranks located at convenient places in the magazine or ammunition passage near the hoist and connected, by an arrangement of shafts and bevel gears, to a clutch on the end of the motor intermediate shaft opposite the hoist. This clutch is operated by a hand lever moving in the plane of the shaft, and is so constructed that when the lever is moved toward the motor the intermediate shaft is connected to the large motor gear and the hoist is electrically driven; but when the lever is moved away from the motor the intermediate shaft is disconnected from the motor gear and is connected to the gearing of the hand gear and the hoist is ready for hand drive. When the lever is thrown for hand drive the intermediate shaft runs freely in the motor gear, and when it is thrown for electric drive the shaft runs freely in the last bevel gear of the hand drive system.

DESCRIPTION OF RAMMERS FOR 13-INCH GUN.—One 5-horse power, 80-volt, series-wound motor is located outboard of each rammer on the 13-inch gun floor.

The shaft couples direct to the rammer, in the mechanism of which is a friction sheave, which may be adjusted so that in case too great obstruction is met, as would occur if the rammer reached its limit before the motor is stopped, this will slip and prevent so great a load as to cause the fuses or circuit breaker to act.

Motors.—The motors are of the armored type. They have four poles, are series-wound, and give an output of 5 horse power at 80 volts with an armature speed of 775 r. p. m.

DESCRIPTION OF ELECTRIC ELEVATING GEAR FOR 13-INCH GUNS.—One 2½ horse power, 80-volt series-wound motor, located in the central girder below the 13-inch gun floor, elevates each 13-inch gun.

It stands with the commutator toward the center line of the turret and drives through a pinion and train of gears.

There is an idler gear inserted in the mechanism of the right gun, in order that the two motors may not be exactly opposite each other and thus render access to the brushes difficult.

It is operated by a controller, situated beneath the telescope under the sighting hood.

The rheostat is located below the controller and the switch panel is fastened to the mantlet plate at a convenient point.

The motors are the same as those used for the 13-inch rammer, except that the field and armature have different windings, so as to give a speed of 300 r. p. m. at 80 volts and 2½ horse power output.

The controlling devices are generally similar in principle to those used with the rammers for the 13-inch guns.

DESCRIPTION OF VENTILATING FANS—50-INCH VENTILATING BLOWERS.—There are ten 50-inch ventilating blowers, each driven by an electric motor, located as follows:

Two on the splinter deck at frame 26, starboard and port.

Two on the splinter deck in the dynamo room at frame 39, starboard and port.

Two on the berth deck at frame 40, starboard and port.

Two in the engine hatch on the main deck.

Two on the splinter deck at frame 65, starboard and port.

Description.—Each blower is direct connected to a 12 horse power electric motor, supported on a shelf projecting from the side of the blower. They are set in pairs, equally distributed between starboard and port.

Description of Motors.—The motors are entirely open, shunt-wound, of the multipolar type, having an output, with 160 volts on the armature, of 12 horse power with an armature speed of 500 r. p. m. With field regulation the speed can be reduced to 400 revolutions, and by running the armature on 80 volts about one-half the above speeds can be obtained.

DESCRIPTION OF DECK WINCHES.—There are two kinds of deck winches used, namely, "Simple Geared" and "Compound Geared." There are four simple geared high speed drum winches on the superstructure deck, and they are commonly called the "Superstructure Deck Winches." The two compound geared winches are located on the main deck, aft, and are called the "Main Deck Winches." Both kinds of winches use the same motor, controller, and rheostats.

The capacity and maximum hoisting speed of these motors are: Superstructure winches, 2,200 pounds at 300 feet per minute; main deck winches, with back gear out, 2,200 pounds at 300 feet per minute, and with back gear in, 13,000 pounds at 50 feet per minute.

Resources of Russia.—The Chemnitz Tageblatt recently published an article on the wealth of Russia, from which I take the following figures, says J. C. Monaghan, of Chemnitz:

Its 8,644,100 square miles of territory extend over one-seventh of the earth's surface—only 3,000,000 less than the entire British Empire. Its waters cover 293,018 square miles. It has fifteen souls to every square mile, or 130,000,000 inhabitants. One-twelfth of the world's population pays tribute to the Czar. It has 11,000,000 men able to fight. It can send 1,255,300 men into the field in a few days, and 1,000,000 men a few days later. Its total prepared fighting force is 2,500,000 men and 497,415 horses. The government owns 16,651 miles of railroad; private parties, 8,000 miles. It has a fleet consisting of 23 battleships, 14 coast defenders, 16 cruisers, 28 cannon boats, and 96 torpedo boats. The marine forces are made up of 1,249 officers, 326 engineers, 38,000 men. Its commercial marine consists of 522 steamers and 2,135 sailing vessels. The river shipping has a fleet of 20,000 ships, manned by 90,350 men.

Russia can be practically independent of the outside world for food since the opening up of Siberia's grain fields. The export of grain last year was 300,000,000 quarters. Famine, once almost unavoidable, is now

limited to one or two districts. Once the railroads reach the interior of these, the danger will disappear. Over the empire's boundless meadows, steppes, and prairies roam, in European Russia alone, 24,609,260 head of cattle, 44,465,450 sheep, 9,243,000 hogs. It cultivates 1,098,507,780 acres of land.

The country is opening mines, draining marshes, clearing forests, putting land hitherto held to be of no value under cultivation. Foreign cotton and corn, tea and tobacco are being tried. In its efforts to emancipate itself from foreign imports, Russia will want machinery, tools, seeds, etc. No nation is better situated to provide these than the United States.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Plague in Bombay: Haffkine Serum.—The plague in the Bombay presidency continues, says Consul W. T. Fee, of Bombay. It had its inception in the latter part of the year 1896, and has spread into every collectorate and district of the presidency. From statements showing the mortality from plague furnished me by the government of India, I find there were, during the week ending September 3, 1899, 4,390 deaths from plague in the presidency of Bombay.

Its progress in the southern Maratha country during the past year has been remarkable. It has assumed an epidemic form in the city of Poona, a place of over 100,000 inhabitants, which, on account of its supposed sanitary condition—high elevation, dry heat, with a climate from May to November like an English spring morning—has been made the home for the Bombay army and the residence of the governor during the monsoon season.

This city has had 23,331 cases and 17,809 deaths from plague up to the present time. The epidemic is just at present at its height, and there is great suffering and distress. During the week ending September 2, 1899, there were 1,086 deaths from plague, and on Monday, September 4, 1899, 117 cases and 110 deaths were reported in that city.

Western India being now threatened with famine on account of the failure of the monsoons to produce the usual amount of rain to nourish the crops and induce late sowing, it is feared that the coming season will witness a further ravage of the plague.

The distance may save America; yet this scourge repeatedly reached Europe in the early centuries. It is now raging in the East, and there is reason to fear that it is gathering force. It has appeared in Alexandria, Egypt, and Oporto, Portugal, which is only a week's journey from the western world, and the mediæval plague is quite capable of taking advantage of modern rapid traveling.

The plague is an acute infective fever; its primary cause is a living organism, a minute microscopical being, which, having gained entrance to the body, multiplies with great rapidity, producing a series of local disturbances giving rise to characteristic symptoms, and diffusing throughout the body a subtle poison which is generally the cause of death.

Our modern physicians are not much better equipped for the treatment of the disease than were their mediæval predecessors. Inoculation, although its results are extremely important and promising, is a prophylactic rather than a treatment, a wall against the enemy rather than a weapon with which to meet it. There are, of course, great advances in the general treatment of the cases, but modern science has not yet discovered a specific against plague.

The plague microbes are capable of living and multiplying only while they have access to supplies of organic nourishment. They are able to pass directly from body to body or to remain alive and even multiply outside of the body. Thus, there are two ways in which plague may travel; it may creep from patient to patient in a direct chain, or it may use places where suitable decaying substances are to be found as temporary links in the chain.

An antitoxine, or serum, first prepared by Professor Haffkine as a plague inoculation, called Haffkine's prophylactic, is now being used in Bombay and western India with remarkable results.

This prophylactic is prepared by first taking the plague bacilli, or the young germs, from a person affected with the plague and cultivating them. These microbes are killed by artificial means and a high degree of heat. From these dead germs and their poisonous excrement is produced a fluid that is believed to have acquired the power, when injected into the human system, to render the blood immune from the attack of plague germs and to neutralize their effect.

The injection of such a poison has the effect of an antitoxine and prevents the system from nourishing plague. A dead plague germ being inoculated into a person, plague will not follow. A person after having one attack of the disease is rarely liable to a second. The person first inoculated is subject to symptoms of the plague. In vaccination for smallpox a living germ is dealt with, whereas in plague inoculation dead seed only are injected.

Experiments are now being carried on at the laboratory at the Government House, Parel, Bombay, where further discovery is expected to perfect this plague preventive.

Strangely enough, inoculation is exceedingly unpopular among the natives. The government has had great labor in pursuading the Hindoo mind of the efficacy of Haffkine's prophylactic against plague, and at the same time its utter harmlessness in every other respect.

The Hindoo is suspicious that the dead germs and their toxic excreta may be of animal rather than vegetable substance, which would make the injection of the fluid into his body a religious offense.

The measures generally relied upon in the dry season were entire evacuation of infected villages and hamlets, isolation of the sick, segregation of the "contacts," and a thorough disinfection of all infected places. In localities where the outbreak grew virulent in the monsoon, evacuation was impossible; but inoculation was extensively tried and strikingly demonstrated the protective power of the prophylactic.

At first, the people failed utterly to understand the use of segregation. To the masses, infection and contagion had no meaning. Nothing but the splendid confidence of the people in the British government could have made sanitary measures possible, in the broadcast and rapid manner in which it became necessary to use them among untrained and uneducated millions.

Owing to the enormous population of the city of Bombay, and also to the fact that many plague cases are suppressed, secreted, or returned under fever or other causes, it is impossible to get general statistics of the effects of Haffkine's plague inoculation. However, I have a few returns from up-country places of the results of inoculation.

At Kirkee, the plague broke out among the royal artillery followers. They were living under far better conditions than many villagers, and a cordon had been drawn around that place. 671 persons were inoculated and 859 not inoculated. Among those inoculated there were 32 attacks and 17 deaths, giving a mortality of 2·05 per cent.; while among the uninoculated there were 143 attacks and 98 deaths, or a mortality of 11·4 per cent.

At Belgaum, among the men of the Twenty-sixth Madras Infantry, after all of the Sepoys had been inoculated, there were only two attacks, both of which recovered, whereas before the inoculation there had been 78 cases in the regiment.

At Ganeshkhind, among the servants of the governor of Bombay, in a certain quarter, there were 324 persons inoculated and 300 uninoculated. Fourteen cases of plague occurred in that quarter, and every one of those cases occurred among the 300 who were not inoculated.

Bacteriological and chemical analyses of the atmosphere and ground air, etc., are being made in these infected places, results of which may be of extreme interest and infinite use in the future.

Plan to Sell Goods in Europe.—I am very much interested in a plan for selling goods, outlined in a letter and circular which I received from an experienced commercial traveler, says Consul Marshal Halstead, of Birmingham.

The letter and circular were sent to me, as he desires to represent upon his next journey over Europe an American manufacturer in each of the following lines: (1) Bedsteads; (2) cycles and motor cars; (3) American hardware and tools; (4) grass mowers, reapers, and binders; (5) laundry and other machinery. On the circular there are printed many testimonials and extracts from letters, showing that he is a man with whom business houses at various times have had satisfactory connections. In his circular, the writer states that he has traveled over Europe, northern Africa, and western Asia for seventeen years in the interests of different engineering firms. Since the beginning of 1897, he travels each year all over Europe (except Greece) for a number of firms whose business does not clash, and represents these firms on "part expenses and commission," his itinerary including Holland, Belgium, Denmark, Sweden, Norway, Finland, northern Russia, central Russia, southern Russia, the Caucasus, Roumania, Austria-Hungary, Germany, Italy, Switzerland, Spain, and France. He says:

"I make a contract for a year, and I engage to travel at least eight months. Last journey took about ten months, instead of eight months. I write from all principal towns and send the orders and report fully.

"In regard to payment of accounts, I am very careful to obtain information on the spot through bankers and forwarding agents; but it is as well to subscribe to such firms as Confidenza, Prudenza, Eckel of Lyons and Basel, etc., by which means an official report costs 4½d. or 5d. (9 to 10 cents) instead of 2s. 6d. (61 cents) in England. My terms are £100 ($486 78) toward expenses of the whole journey and commission of 3 per cent. on new accounts and 2 per cent. on all old accounts from the ground I cover, but no commission wherever there are agents already. I collect accounts or do any business required. If my employers or their sons or friends choose to go on a journey with me, I undertake to teach them French, German, Italian, or Spanish in my spare time without extra charge, and to give them the full benefit of twenty years' commercial experience in Continental countries. Highest references and guarantees."

I am not writing this to recommend the man, but the plan, though I have given him the names of the American manufacturers he desired.

Swedish Regulations on Imports of Horse Meat.—Consul Bergh writes from Gothenburg, October 26, 1899:

Custom house officials here will not accept the veterinarian's name stamped on the Agricultural Department's certificate and stamp, but insist that the name of the inspecting veterinarian shall be hand-written. It is further demanded that each of the barrels shall be sealed at both ends, at one end in the following way: First, the stamp of the Department of Agriculture pasted on in the center of the barrel head, then by a wire drawn across the head, through the chine, and the ends brought together and secured by lead seal right on the Agricultural Department's stamp, this stamp as well as the lead seal to be covered with the usual protecting tin plate; at the other end of the barrel, wire and lead seal only to be used.

New Russian Railways.—Vice and Acting Consul Monaghan writes from Chemnitz, October 25, 1899:

Russia has sent engineers to the left bank of the Ural River to survey the country lying between Orenburg and Taschkent. She intends to build a railroad to connect these two cities. This line will cross Turkestan. Another line is to run from Alexandrowo through the Transcaspian country along the left bank of the Amoor as far as Tschardschin. The object of these railroads is to connect Russia with the commercial centers of middle Asia, and ultimately with the Indian Ocean. These railroads will work wonders in developing the cotton-producing countries through which they will pass—i. e., Turkestan, Bokhara, and Khiva.

American Apples in Germany.—The first shipment of American apples for Germany reached Bremen this month (September), says Consul Geo. Sawter, of Glauchau. The export season for apples has therefore begun several weeks earlier than was the case last year, and under very favorable conditions, generally speaking, as a rich harvest has been reported from every part of our country where apples are grown, whereas the apple harvest in Europe is below the average. A good result from this year's export of apples to Europe is, however, by no means certain, owing to the keen competition of the Canadian products. Not only in the United States, but in Canada and Nova Scotia, this year's apple harvest leaves a large surplus for export, and this of excellent quality. Moreover, as the Canadian producers exercise greater care in the sorting and packing of the fruit than is the case with us, and as the cost of production is less, while the freight to Europe from Canadian ports is from 10 to 12 cents lower per barrel than from American ports, the Canadian exporters find themselves more advantageously situated than our own.

The total export of apples from American ports to Europe for the season of 1898–99 was 1,221,087 barrels; in the season 1897–98 it was only 913,996 barrels; whereas in 1896–97 it amounted to 2,919,876 barrels—the highest export figures ever reached. From the present harvest returns, one may count upon about the same amount of export as in 1896–97.

The first shipments of any great importance took place in the season of 1879–80. In the following season (1880–81), the export figures had already reached 1,250,000 barrels. At that time the shipments were made almost exclusively from New York, whereas since then other ports, and notably Boston, have acquired importance in connection with the export of apples.

The largest European markets for American apples are Glasgow, Liverpool, and London. Last year, Germany took only 22,861 barrels from the United States. It is probable, however, that the shipments to this empire will increase this year to 100,000 barrels or more.

Iron Bedsteads in Canada.—Consul Martin, of Amherstburg, on October 30, 1899, says:

I desire to call the attention of manufacturers of iron and brass bedsteads to the opportunity offered in Canada for the establishment of one or more factories for their manufacture. Many of the dealers throughout Canada are at the present time buying their iron and brass goods in the United States and paying the duty of 30 per cent., while the iron and brass from which they are made are free of duty under item 617 of the Canadian customs act of 1897, viz.:

Tubes, rolled iron, not welded or joined, under 1½ inches in diameter; angle iron, 9 and 10 gage, not over 1½ inches wide; iron tubing, lacquered or brass covered, not over 1½ inches in diameter—all of which are to be cut to lengths for the manufacture of bedsteads, and are to be used for no other purpose; and brass trimmings for bedsteads, when imported by or for manufacturers of iron or brass bedsteads to be used for such purposes only in their own factories, until such time as any of the said articles are manufactured in Canada.

German Trade and Industry.—Consul Winter writes from Annaberg, October 11, 1899:

Germany's export trade continues to increase. Through recent treaties with Japan and Spain, exporters look for a still greater gain.

The figures for the first half of the present year make an extraordinary showing, and this result is based upon the increased exports to the United States. Germany also sold much more to Great Britain during the first half of 1899 than during the same period of 1898. During the first half of 1899, one hundred and eighty-two joint-stock companies were organized in the German Empire. Their capital was invested for the most part in establishing new banks, in opening mines, in electrical undertakings, and in building breweries. The new Dortmund-Ems Canal, connecting the Elbe and the Rhine, giving cheap transportation to the inland cities of Germany in connection with ocean freights, will undoubtedly stimulate foreign commerce in a large degree.

Catalogues Free of Duty in Canada.—Consul Ledoux, of Three Rivers, on October 24, 1899, says:

A dispatch received this day from Ottawa announces that an order in council has been passed providing that bona fide catalogues and price lists of goods in any country beyond the limits of Canada, not exceeding three to any one address, shall be admitted through the mails or other conveyance free of customs duty, provided, however, that such catalogues and price lists shall not be held to include almanacs or advertising periodicals or printed matter designed to advertise the sale of goods by any person in Canada.

This innovation will greatly benefit United States exporters issuing large catalogues, as the Canadian recipients of these catalogues had to pay 15 cents per pound duty, and in many cases refused to pay this amount and left them with the customs officers.

Electric Tramway in Calais.—Consul Milner, of Calais, under date of October 30, 1899, informs the Department that a company organized at Paris is arranging to establish an electric railway in Calais. The equipment has not yet been purchased, and the consul thinks that United States manufacturers may wish to bid. The old tram-cars now in use are of American make.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 600. December 11.—Railways in Africa—Telegraph, Transportation, and Supplies at Dawson—Coal in Germany.

No. 601. December 12.—Opportunities for American Capital in Mexico—*Canadian Sea Grass for Upholstering.

No. 602. December 13.—Tariff of Salvador—The Agricultural Products of North China.

No. 603. December 14.—Necessity for Best Seed in Sugar-Beet Cultivation—Trade of Fiji in 1898—Failures in the Diamond Trade at Antwerp.

No. 604. December 15.—Nickel Mining in Ontario—Table Salt in Uruguay—Agriculture in the Yukon.

No. 605. December 16.—French Commerce with Indo China—World's Production of Gold and Silver; Report of the French Mint—Alleged Bubonic Plague in Paraguay.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

GLASS POISONING.

WE understand that a case is shortly to come before one of the criminal courts in America which will be of unusual interest. A woman is charged with the murder of an aged husband by feeding him with glass ground up in an ordinary coffee mill. The glass is thought to have been given in oatmeal porridge. This method of poisoning is supposed to have been a favorite one in the sixteenth century, and is said to be still practiced among savage tribes who have access to the needful material. Medical literature, however, contains but few recorded cases. Glass may be a "noxious substance" by virtue of the mechanical injuries which it can produce, but it is not therefore a poison in the legal sense of the word. A case of this nature with references to previous observers is recorded in the Edinburgh Medical and Surgical Journal for 1824, p. 225. Dr. W. Turner, of Spanish Town, Jamaica, there relates that an attempt was made by a negro woman to poison a whole family with pounded glass. The persons on whom the attempt was made were seven in number, and none of them suffered any inconvenience. In the Midland Medical and Surgical Reporter, 1828, p. 47, Mr. William Hebb, surgeon, of Worcester, records in considerable detail the case of an infant who was destroyed "by some person or persons administering to it a quantity of roughly pounded glass." A considerable quantity of gritty powder, proved to be powdered glass, was found in the stomach, which "was lined with a thick layer of tenacious mucus which was streaked with blood, and it required to be peeled off before the villous coat beneath could be exposed to view. This last was in a state of amazing vascularity." Another case is reported in the Allgemeine Wiener Medicinische Zeitung, 1863, viii., 254. A case of attempted suicide by this means is recorded in the Boston Medical and Surgical Journal, 1871, p. 191. A young girl, aged sixteen years, desiring to end her life, pounded up a small glass bottle into fragments of the size of a split pea and under; of these she swallowed a teaspoonful, taken at several times in bread. Although she experienced considerable pain and discomfort, she subsequently recovered. The favorable result may have been due to the bread protecting the stomach and intestines from injury. The small number of cases on record and the immunity which experimenters have enjoyed from harm after swallowing powdered glass would show that death produced by these means is not nearly as common as the remarks usually to be found in medico-legal text books would lead the reader to imagine. In an inaugural dissertation published in Paris in 1820 by Le Sauvage, it is stated that 2½ drachms were given to a cat without injury, also that a dog took 6 ounces or 7 ounces in eight days without any symptoms manifesting themselves. Le Sauvage himself swallowed a considerable number of similar particles without sustaining any inconvenience. Professors Baudelocque and Chaussier in 1808 reported a case at Paris in which the prisoner was supposed to have poisoned his wife with pounded glass. This substance was actually found in the stomach of the deceased, and this organ as well as the intestines exhibited signs of great irritation. After a careful consideration of all that had been written on the subject, however, they gave their opinion that pounded glass is not a poison, and suggested that the glass in the stomach was derived from some vessel of that material being broken by her teeth during the convulsions which preceded death.—Lancet.

[Continued from SUPPLEMENT, No. 1251, page 20048.]

LONG-SPAN BRIDGES.*

By Prof. W. H. BURR, of Columbia University.

SINCE very high working stresses can be used, and since there are few main members of the structure, it is obvious that the stiffened suspension bridge (Figs. 6, 7 and 8) would be utterly unfit for short spans. We should have members too light and flexible, and given to too much vibration; hence, they would be ill calculated to take moving loads. Under the circumstances of shorter spans than those which are required for the longest crossings, we may use what is practically a stiffened suspension bridge turned over; i.e., with the cable displaced by a compression member; in other words, by the arched rib (Figs. 1, 2 and 4), which, in my opinion, is a form of structure that will be very much employed in the future. The arched rib is not adapted to every short crossing, but for many crossings where the long-span feature is desirable, and where the conditions are such as to require a graceful, and at the same time stiff, bridge, it is an excellent structure. As a matter of fact, a stiffened suspension bridge and a stiffened arch are so nearly alike that precisely the same analysis will answer for both—that is, one may establish general formulæ for the computation of stresses in the main members of the stiffened arch, and apply them directly to the stiffened suspension bridge, or vice versa. A general analysis of the type of stiffened structures will give a system of equations which may be developed for special features in each of the two cases; but, so far as the main equations are concerned, they are the same for both. In each the stresses in general are carried very directly from the points of application of loading to the reactions. The only modification of that observation (and it is a partial modification only) lies in its application to the metal which is required to hold the curved members (whether in tension or compression) in their proper alinement under the action of the moving loads.

I shall call your attention only to some diagrams of some skeleton stiffened suspension bridges; although in each case we can turn them over, subjecting the main members to compression, and thus have the stiffened arch. At the present time there has not been a sufficient number of designs of stiffened suspension bridges made to determine just what method of stiffening is the best for every given span; yet, in developing the stiffened suspension bridge, it is necessary to take into consideration in just what manner the stiffening metal shall be placed. Certain stiffened suspension bridges have been built of what one may call the modern type, but not of long span. The old Brooklyn Bridge (Fig. 8), and the new East River suspension bridge (Fig. 7), are examples of what we may call the older type of suspension bridge construction. In those bridges the stiffening metal is placed in a stiffening truss, along the lower chord of which the moving load is carried. That illustrates the general type of stiffened suspension bridge, in which the shape of the cable is maintained by an entirely independent member—the stiffening truss. The scale sketch shows the general type of such structures, although the joint at the center (Fig. 6) is absent from the stiffening trusses of both the Brooklyn bridges. The stiffening truss which is used in connection with such structures may be continuous from end to end of the span, and be anchored down at each end, but in such a way as to permit horizontal movement at those

FIG. 1.—ARCHED RIB—THE MÜNGSTEN BRIDGE.
Total length, 1,590 feet; span of arch, 557·6 feet; depth from floor to river, 354 feet.

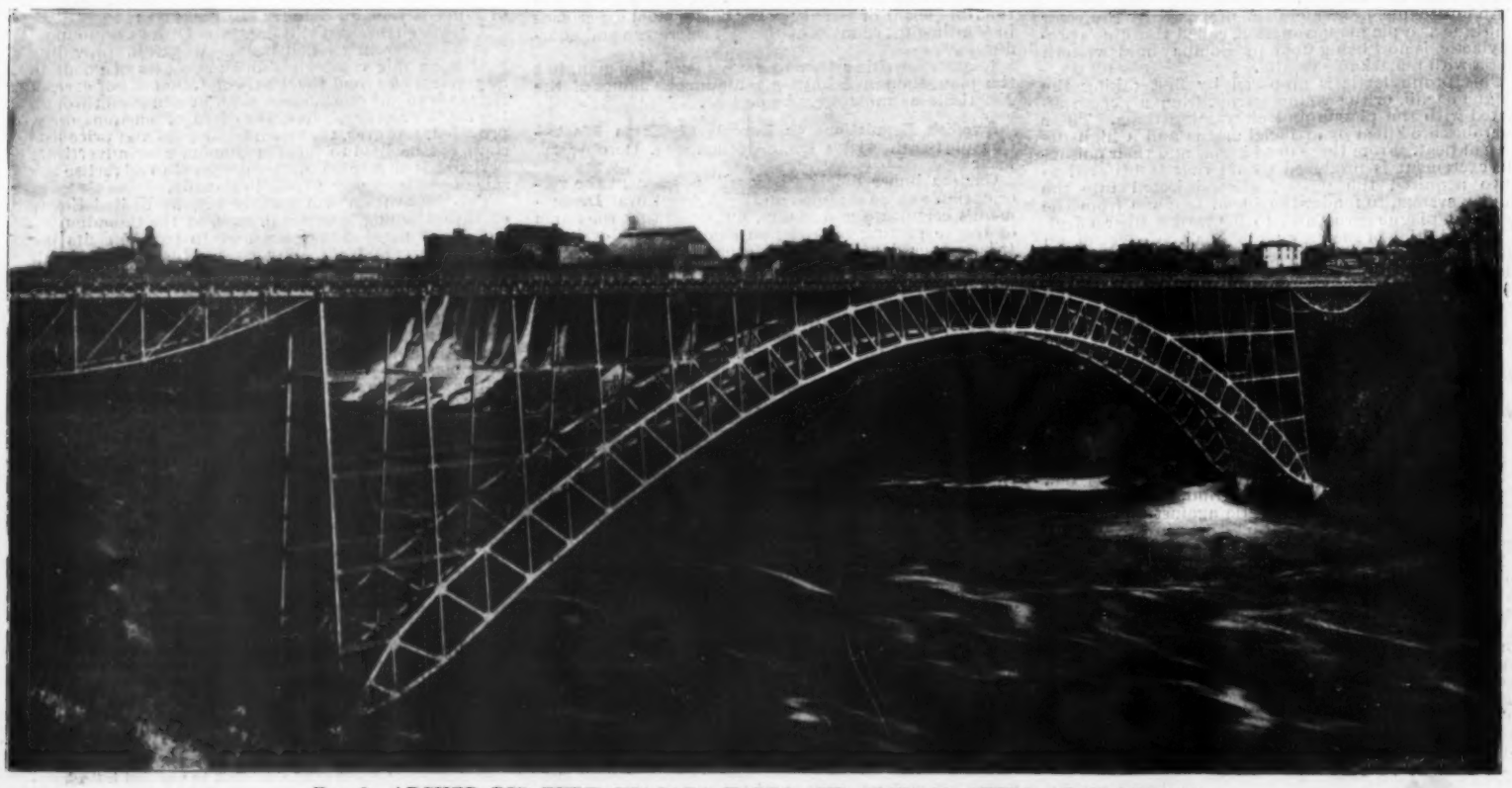


FIG. 2.—ARCHED RIB TYPE—NIAGARA FALLS AND CLIFTON STEEL ARCH BRIDGE.
Span, 840 feet; rise, 150 feet.

* An address delivered November 4, 1899, before the Engineers' Club, of Philadelphia. Revised by the author for the SCIENTIFIC AMERICAN SUPPLEMENT. The illustrations herewith given are supplied by the SCIENTIFIC AMERICAN to replace the views used at the lecture.

ends, or it may be anchored down in precisely the same manner and be jointed at the center, as shown; or, again (what in some ways is a decided improvement), the joint at the center may be omitted and the stiffening trusses made continuous and carried back of the towers to be anchored down at their extremities. I think no such structure has been built; but such trusses have been designed. In that case there would be a point of support to the stiffening truss at the tower at each end. There would be rocking struts, extending down to such elevations as may be best suited to accomplish their purposes at both the towers and at the ends of the trusses, to serve as points of anchorage and support. This type of stiffening truss has some advantages.

The type which is illustrated by the Brooklyn bridges is the oldest; in it the cable is used simply to sustain the dead load of the structures and the moving or live load. The entire stiffening effect—that is, the distribution of the moving load (whatever may be its location) in such a way as to stress the cable in its constant and normal position—is a straight member. The backstays may be carried in a straight line if they are supported (Figs. 6 and 7), or they may be allowed to take their natural curve (Brooklyn Bridge, Fig. 8, and North River Bridge). Obviously, if the cable can be made economically to hold its position under a traveling load, there will result the conditions for an extremely economic structure.

It is always assumed that the curve of the cable is parabolic; but if the live load covers any portion of the span, the tendency is to deflect the cable in that portion and to raise it in the other part of the span. Inasmuch as the parabolic curve necessitates a uniform distribution over a straight line of all the vertical loading, it is clear that the stiffening truss must act in such a way (no matter what portion of the span is loaded) that all the suspenders from one end of the span to the other will be stressed uniformly. This is, probably, seldom exactly true in any case; but it may be so nearly true that the disturbance of the cable is too small to be of any material consideration.

The old theory of the stiffening truss was such as to obviate the use of any equations in the theory of the stiffening truss which involved the elastic properties of the material. It virtually assumed that all the suspension rods and the cables were rigid, incapable of extension, and that the stiffening trusses themselves were without deflection under any condition of loading, making the problem one of pure statics. The fundamental equations of conditions from which the bending moment and the shears were computed, and by the aid of which all members were designed, thus involved in no way whatever equations of elasticity.

The modern system of stiffened suspension bridge design is somewhat more advanced. It is of such a character that the stretch of the suspension rods, the stretch of the cables, the deflection of the stiffening trusses, and even the compression of the towers, if desired, is taken into consideration. The constant horizontal component of stress in the cable is determined on the condition that the total work of elastic distortion of all these members shall be the least possible. The equation or condition of least work, as it is called, is, so to speak, the elastic supplement to the ordinary equations of static equilibrium necessary for a sufficient number of equations to determine all the unknown quantities of stress computation. It is not a theory which involves any great amount of work, although it is a little more laborious than the old method. At any rate, the amount of labor involved is certainly small in view of the importance of securing as nearly accurate design as possible. No one need be afraid of occasional mathematical equations, but wherever a substantial advance in engineering design can be secured, the small additional labor of computation which is involved in making that advance is a very small price to pay for it. Every essential advance in structural design which has been made in this country during the past thirty years, has largely involved just such advance in analysis as is required in passing from the old static theory of stiffening trusses to the more advanced and satisfactory one.

I have dwelt upon this matter a little more than perhaps may seem necessary, because it has been alleged in some quarters that even this theory is too loosely approximate to have any advantage over the old; that the suspension rods are of different lengths, and consequently that they are stretched differently; that the deflection of the truss will not be quite as is assumed in the equations of the theory; that it is a question how much the towers will be compressed and how much the masonry, and, after all, inasmuch as we cannot reach a theory absolutely correct, there is no use in attempting such refinement at all. Such views, however, are in opposition to all progress. It is impossible for a human being to do anything perfectly right; but the ideal can be approached more and more, if we recognize the necessity and the advantage of doing it; and that is precisely what should be done in connection with this suspension bridge theory. There is in the most advanced analysis a perfectly rational basis for at least recognizing the main features of the conditions which hold in the design of such structures; and it seems to me, as to professional men who are in earnest in professional work, that those features should be recognized in the analysis employed.

The maxima bending-moments and shears in the stiffening truss for the new theory and the old are not very different, and the latter may well be used for approximate estimates. The chord stresses and shears in individual members may, however, be very different,

FIG. 4.—ARCHED RIB—LEVENSAU BRIDGE ACROSS THE KIEL CANAL.

Span, 536 feet.

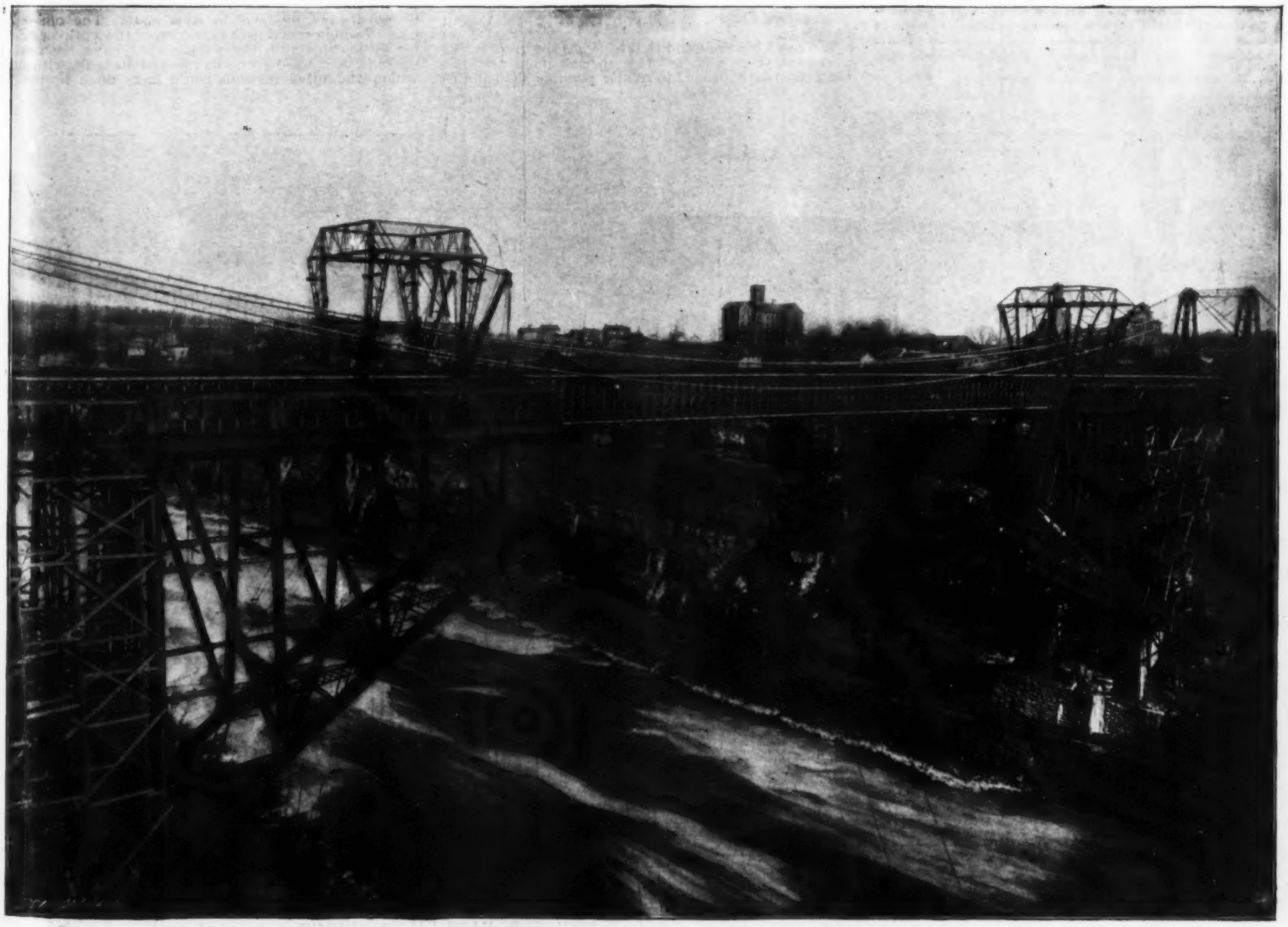


FIG. 3.—ARCHED TRUSS TYPE—NIAGARA RAILWAY ARCH BRIDGE.

Span, 550 feet; rise, 114 feet.

and the new theory should be employed for final calculations. The greatest value of moments and shears in the two cases are as follows, very closely:

	p = load for line H. Old theory.	z = length of span in feet. New theory.	
Max. mold.....	M = 0·01856 pt.²	M = 0·01652 pt.²	No center hinge.
Max. shear	S = ½ pt.	S = ½ pt.	
With center hinge.	M = 0·1881 pt.² and	S = ½ pt.	

(To be continued.)

PROGRESS OF THE MECHANIC ARTS IN THE LAST THREE-QUARTERS OF A CENTURY.*

By COLEMAN SELLERS, M.D.

IN looking back to the time when the Franklin Institute celebrated the first half century of its life, I recall the speakers on that occasion, and regret exceedingly that some of those who addressed the meeting are unable to take part in the present celebration. I had the honor at that time to be president of the Institute, and presided at the meeting held in Musical Fund Hall. Among the speakers was Mr. Frederick Fraley, who delivered the historical address, he being one of the two survivors of the original founders of the Institute. Mr. Fraley is still with us, and is now the only survivor of those few men who had the good of the mechanic and craftsman at heart when they established what has proved to be among the most successful in its practical results of all institutes of the kind in the world. I regret that the condition of Mr. Fraley's health prevents him from being able to address you at this time, but I know that in heart he is with us, as he has been for the past three-quarters of a century.

The scope of the subject upon which I have been asked to address you merits careful preparation, in order to present it in a sufficiently comprehensive shape for the limits of a single address. I regret extremely that I have not had an opportunity for such preparation, and can offer therefore some informal remarks only, covering a few recollections and observations on the progress of the mechanic arts during the past seventy-five years. The records of the Franklin Institute are the records of much of the progress made during the whole of this time, and in the volumes of its journal you will find abundant evidence of the good work of the earnest mechanics, engineers, and teachers who came together for their mutual benefit and in the interest of this society. You will find no better place to note the progress of the mechanic arts than in the account of the work of these citizens of a great manufacturing city, in the reports of the committees of the Franklin Institute, and especially the committee on science and the arts, which for many years performed gratuitously what is now largely confided to paid experts. These men did this work of the Institute and are still doing it for the country's good, without any expectation of other reward than comes from the satisfaction of unselfish interest in mechanical progress.

The greatest advance in mechanics has been manifested since the advent of the locomotive. It so happens that the birth of the modern railroad system is coincident with my own birth. At that time the first railroad was put into operation in England, which development, taken in connection with the advent of the steamboat, which preceded it, was certainly the exciting cause of the greatest industrial advance that has since been made. Previous to 1827 wooden rails had been laid to form roads over which ore was hauled from the mines, and coal was transported in the same manner by animal traction to better advantage than over common roads. Oliver Evans in our own country, and other engineers abroad, had conceived the idea of the high pressure steam engine, and with the full understanding of its value, a practical traction engine was one of the first examples of its application to use on roads. It was after the invention of the road engine that the locomotive upon rails became possible.

With the traction engine united to the railroad we have the contribution to commerce that has made our present wonderful system of inland intercommunication between all parts of the country, and has given an impetus to all other trades. In fact, the wants of the railroads themselves taken alone would have been sufficient incentive for what has been done in the mechanic arts, engaging the attention of all the engineers who could be enlisted in their service, to produce the labor-saving tools required for the progress and preservation of the railroads, to say nothing of the great iron and steel works that supply the rails, bridges, and buildings.

You must bear in mind that to create the great works that have since been erected, special machinery has been constantly needed to render possible such industries as ship building, bridge and structural work, textile machinery which has replaced the hand loom and the spinning wheel.

The progress of the single industry of machine tool building has therefore a most important bearing on this subject, and traced through the many stages of its rapid growth, the development of this one industry would be sufficient to illustrate the progress in mechanic arts during the period in question, and especially what has been accomplished in this country. The important relation which tools and implements bear to the mechanic arts, and in fact to all arts and crafts, forms the subject of an interesting tradition which was published in the Journal of the Institute by the late Mr. Joseph Harrison, Jr. In his home at Philadelphia he exhibited a painting by Schusselle representing a blacksmith seated at the right hand of King Solomon's throne in his great temple, to illustrate an hypothetical event during the feast given in Jerusalem at the completion of the edifice. To this feast had been bidden the various artisans who had been engaged upon the construction and decoration of the building, those who had helped to shape the gold and silver and carve the ivory and weave the costly hangings that decorated its walls. There also came, unbidden and unrecognized, the swarthy smith, forcing his way through the courtiers and the guard to the throne of the king, he claiming recognition as the one man to whom was due the creation of the entire work, for without his skill the work would have been impossible, as it was he who had forged the tools, without which the other artisans could have done nothing.

* Address delivered at National Export Exposition before the mechanical section of the Franklin Institute, Philadelphia, on Thursday, October 5, 1899. Revised by the author.

FIG. 5.—ARCHED RIB—GRÜNENTHAL BRIDGE ACROSS THE KIEL CANAL.

Span, 511·7 feet.

FIG. 6.—STIFFENED SUSPENSION BRIDGE—PROPOSED NORTH RIVER BRIDGE.

Span, 3,100 feet.

FIG. 7.—STIFFENED SUSPENSION BRIDGE—THE NEW EAST RIVER BRIDGE.

Length between terminals, 7,200 feet; length of main span, 1,600 feet; extreme width of bridge, 118 feet; height of floor above high water, 135 feet; height of cables at top of towers above high water, 382 feet.

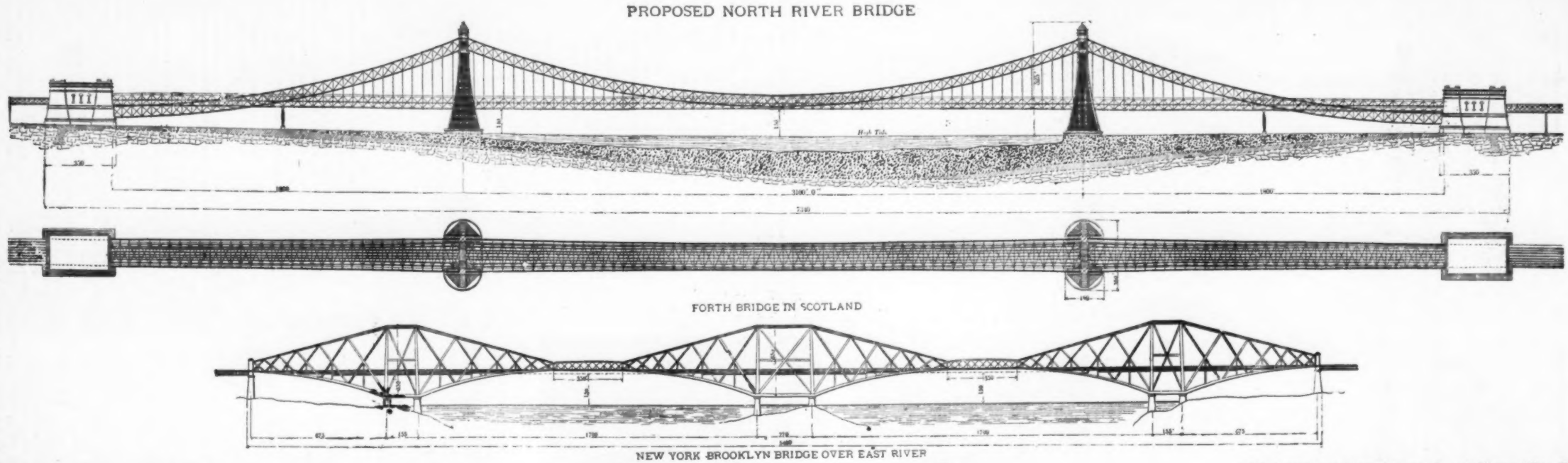

PROPOSED NORTH RIVER BRIDGE
FORTH BRIDGE IN SCOTLAND
NEW YORK BROOKLYN BRIDGE OVER EAST RIVER
POUGHKEEPSIE BRIDGE OVER HUDSON RIVER
ST LOUIS BRIDGE OVER MISSISSIPPI RIVER

FIG. 8.—TYPES OF LONG-SPAN BRIDGES.

STIFFENED SUSPENSION TYPE—North River and New York-Brooklyn.
CANTILEVER TYPE—Forth and Poughkeepsie.
ARCHED RIB TYPE—St. Louis.

The wise king, recognizing the justice of the claim, gave to the smith the seat of honor.

Antedating the smith of King Solomon's day and the mechanics of all times, the progress of civilization can be traced by the study of the implements used in the daily life of different races of men; and prominent in the progress of the mechanic arts must be counted the tools with which work has been accomplished.

As one instance of progress from primitive methods during the period under consideration, it may be of interest to refer to the construction of one of the first large engines that was built for the city water works in Philadelphia. There is probably no one present who can recall the fact from actual memory; but where our public buildings now stand there once stood a smaller structure, on top of which was a tank into which water was pumped, and this water was distributed through the then small city below Broad Street by means of wooden pipes of comparatively small size. The engine used in this work was, I believe, of the Oliver Evans type of high pressure engine, the cylinder of which was cast in New Jersey. The boring bar used in boring out the cylinder was of the crudest character, operated by hand by means of levers attached to it, so that men walking around the cylinder could propel the cutting tools, and gradually force the cutters on the boring bar, through the cylinder, until it had been turned out approximately true. After that the inner surface had to be filed to a sufficient degree of smoothness. Probably a month was consumed in this operation of boring the cylinder. As I shall take occasion to mention, the subsequent improvements in machine tools have changed the process of cylinder boring from an effort of days to the work of a few hours.

It may be of interest also to note that when the engines were erected and the boilers put in their place at this Center Square Station, the latter were found upon test to be insufficient for their purpose. Oliver Evans had specified the length of the grate bars and the width of the furnace to be used, as also the length of the boilers, which were of the plain cylinder type; but the wise men of the city government believed that they could do better by making the boilers much longer than he had suggested, and they were so constructed. Upon their failure to do the work, Oliver Evans, who was in New York, was sent for in haste to correct the difficulty. His message to those in charge, enforced by his presence afterward, was that they must cut off 10 feet from the length of each boiler. This seemed a strange proceeding; but he soon explained to them that the extra length which they had added to his prescribed dimensions was acting as a condenser to re-convert steam into water, inasmuch as the heat of the furnace could not extend the whole length of the boilers as they had been built. Upon cutting the boilers down to their proper size, so the heat could extend over their whole fire surface, they proved sufficient for their work, and continued to operate as long as this primitive water plant was in existence. I have this story from those who were living at the time.

I hope I may be pardoned for alluding here to some events in my own experience as a mechanic in order to justify my authority as a historian. From earliest childhood my interest has been led in the direction of the mechanic arts. My first knowledge of physics came from my father, through his instructions and experiments for my benefit before I had fairly passed out of the stage of infancy; for I was but seven years old when I lost so able a teacher. As a school boy most of my holidays were spent in his machine works at Cardington near Philadelphia, where I had abundant opportunity to not only know what was being done at that time, but I had from my seniors the history of what had immediately preceded my personal observation.

My acquaintance with the rapid advance in the railroads of America, and in the motive power on the roads, dates from the time when the building of locomotives was undertaken in my father's shops, immediately after Matthew Baldwin had started his works in Philadelphia. When I was but 19 years of age, I accepted service as draughtsman in a rolling mill in Cincinnati, Ohio, where rails were made for the railroads then being projected through the Western States. The rails used at that time, which were called strap rails, were flat bars of iron about 3 inches by 1¼ inches in section, with oval depressions rolled into the face to receive the head of the spikes driven through the rail to fasten it to string pieces of wood. They were punched at each one of these depressions, which marked the location of the spike hole. At that time the most common accident on the railroads was one unknown now, namely, "snake heads" as they were called, when the strap rails, by the action of the wheels upon them, would curl up, drawing the spikes from the wood, and often piercing the bottom of the car, and not infrequently killing or injuring passengers.

After my experience in the rolling mill, where I acquired a knowledge of the wants of the railroads, I was engaged for seven years in locomotive building, first in constructing engines for the Panama Railroad, in connection with one of my brothers, who was the inventor of a locomotive for ascending inclined planes. The late John C. Trautwine was the consulting engineer of the Panama Railroad, and it was on his recommendation that these engines were ordered, in the belief that some heavy inclines would have to be overcome in passing from the Atlantic to the Pacific Ocean at Panama, although these inclines were avoided, and the engines used eventually in the construction work merely.

Subsequently I entered the locomotive works of Niles & Company, of Cincinnati, as foreman for five years until 1857, when I accepted service as chief engineer for William Sellers & Company, of Philadelphia, then, as now, engaged in building machine tools.

Thirty years active experience in machine tool building enables me to speak from a full knowledge of this industry and what machine tools have done for the advance of the mechanic arts. When engaged in locomotive building in Cincinnati, I introduced a number of improved methods, but was hampered continually for the want of machine tools powerful enough to do the work as I desired it done, as well as for the want of special tools not then available. At that time in the eastern cities certain machine tools were being built with success and were doing far better work than was then possible with tools built in a branch of the locomotive works where I was engaged. The firm of Niles & Company had, however, some reputation even then as builders of machine tools and sugar machinery, but it was not until the retirement of the original

founders of the house that the works became devoted wholly to the machine tool business. At the time I speak of, slotters, horizontal boring machines and lathes of various kinds and quality were built in America after the introduction of the planing machine, the first one of which was probably introduced into the city of Philadelphia some time about 1830.

The early machine tools were of the crudest workmanship, and most of the lathes were made partly of wood. In fact, the transition from wood to iron in the construction of machinery was in progress during the early part of this century; and the formation of the tools themselves and much of the machinery built at that time involved the conversion of structural shapes required for wooden machines into similar shapes in metal. In the first change from wood to metal, architectural shapes and ornamentation were considered desirable to make machine tools and other machinery meet what seems to us now the rather barbaric taste of those who were to use them. The same might be said of locomotives, which almost up to the 60's were elaborately decorated with paint, polished brass and scroll work. England gave us the first good machine tools, and set the example which has tended to simplicity in design. To that country we owe much that is valuable, not only in the direction of self-actin,, machine tools, but also in the various appliances for improving the character and quality of work to be accomplished. Thus Sir Joseph Whitworth, one of the earliest makers of superior machine tools in England, aimed at utility and not ornamentation in the improvement of his products. It was he who introduced surface plates for producing other plane surfaces by means of the scraper; that is to say, after a surface had been made comparatively true on the planing machine, it had yet to be brought to a commercially true plane by a process of scraping off the higher projections, until when tested by one of the Whitworth surface plates it seemed to touch at intervals of not more than one-quarter inch.

After scraping had come to be recognized as the only means of making true plane surfaces, there followed unfortunately a form of deception that exists, I am sorry to say, not only in America, but still more prominently in some of the copies of American machine tools produced abroad, namely, the practice of scraping the surface without any special regard to the purpose for which the operation is intended, but rather to give it the appearance of having been carefully fitted, and the surface so produced was very aptly called by the late Mr. William B. Bement, of Philadelphia, "bed-quilt scraping." The parts touched by the scraper in this imitation work are very often not irregular in design, but constitute a set figure or pattern which cannot deceive the eye of those familiar with good work.

Long before the time of the International Exhibition of 1851, America had begun to take her place in machine tool building, under a clearly distinct line of thought that was for a long time not appreciated in other countries. When visiting England in 1884, I was shown a copy of an American planer adopted for planing the stub ends of connecting rods for locomotives, there being two sets of uprights and two crossheads with four tool holders adjustable in position to enable both ends of two connecting rods to be planed simultaneously. The American tool from which the idea was taken has its crossheads facing one another and the table is speeded to run back and forth at the same rate of cut. By this means the machine is made to take a cut at each forward and backward movement of the table. The English machine had its tool holders facing in one direction, and all four cuts were taken at one and the same time, only when the table was running forward, no work being done at the back stroke. The power of the American machine was therefore double that of its English copy, all other things being equal, and the maker was astonished when this was pointed out to him.

This one example shows how difficult it is to copy the machinery of another country if the copyist does not grasp the controlling idea of the mind that gave life to the original. Instances of this are found in many other directions where American contrivances, having obtained a world-wide reputation, are less efficient in the foreign copy than in the original production.

The planing machine is an invention well within my own experience. In the beginning it had the platen, upon which the work is fixed, dragged backward and forward by a chain. The first planer that the establishment of William Sellers & Company, of Philadelphia, purchased and put into use was one of this chain pattern, and one was introduced in my father's shops when he undertook to build a locomotive in 1834. At the time of the Vienna Exposition, where machine tools from Philadelphia were exhibited, the engineers sent by the British government to Vienna to note the progress that was being made, noticed the broad feed cut on all the planing machines, lathes and tools that came from all parts of America, and remarked upon it as "producing good effect," as "looking well," etc., as if it were a feature for looks only, not knowing that it was a principle that had been established in America, thoroughly understood not only by the managers of the works, but by workmen all over this country, and universally adopted as a necessity of good work.

(To be continued.)

JEWS IN PALESTINE.

IN view of the impetus given the Zionist movement by the second Zionist congress, held at Basel in September, and also by the Palestine journey of Emperor Wilhelm II., the present status of Jews in Palestine becomes a matter of general interest.

Out of a total population in Palestine of some 200,000 souls, about 40,000 are Jews, as against 14,000 twenty years ago. In Jerusalem, there are 22,000 Jews, half of whom have immigrated from Europe and America and are called Aschkenazim to distinguish them from the Oriental Israelites, the Sephardists.

Nine hundred and sixty families, numbering about 5,000 souls, inhabit the twenty-two Jewish colonies in Palestine which have been founded and subsidized by Europeans, ten by Baron Edmond de Rothschild, representing the Alliance Israélite Universelle; the rest by the Jewish Colonization Association and by the Odessa Company.

The idea of gathering in Palestine homeless Jews scattered all over the globe was championed in the forties by Moses Montefiore, but with indifferent success. In the eighties, however, the immigration of Jews to Palestine assumed significant proportions.

Of the twenty-two present colonies, the "Jacob Memorial" is the largest, supporting more than 1,000 souls. It boasts a graded school (five teachers), a synagogue, etc., and 4,000 acres of land under cultivation, on which are raised fruit (chiefly grapes), honey, and mulberry leaves, the rearing of silkworms being a leading industry.

The "First to Zion" is another quite important colony, owning 2,000 acres of land. Some forty two-storied stone dwelling houses greet the eye of the approaching stranger; also a school house with a Hebrew library, a synagogue, and a hospital. 1,500,000 vines and 25,000 olive, almond, orange, and mulberry trees belong to this colony, which also possesses famous wine cellars.

The "Hope of Israel," a mile beyond Yafa, in the Plains of Sharon, is perhaps best known for its agricultural school, in which one hundred or more pupils are taught gardening. Recently, a high school for Jewish girls was established in Yafa.

The "Head Corner Stone," amid the hills beyond Tiberias, with snow-capped Hermon in the background, is another quite prosperous Jewish colony in Palestine. Being near the source of the Jordan, water is plentiful; and its situation, high up above the level of Lake Gennesareth, insures fair climatic conditions.

In the "Door of Hope," dairy farming is profitably followed and experiments made in tea planting. This colony is said to have 1,000,000 vines.

Entirely irrespective of whether or not the Zionists will succeed in awakening in the Jewish people a national spirit and forming a Judean monarchy or republic with its parliament in Jerusalem and its representation in foreign capitals, the present agitation makes for the development of a country which is but a shadow of its former self, and which will generously respond to modern influences. The sultan seems quite disposed to grant railway, harbor, and other franchises, and it is possible that the new Jewish Colonial Bank, the organization of which was decided upon in Basel, will be permitted, under certain guarantees, to play an important part in the industrial advancement and growth of Palestine. The movement is furthermore bringing out new qualities in the Jews residing in Palestine. They are no longer content with studying the Talmud and living on charity, but are waking to the fact, as the Hebrew would put it, that to till the ground is worship of God.

It should not be inferred from statements here made that peace and prosperity have suddenly become the lot of the Jews in Palestine. Only a few days ago, Rev. William King Eddy, of Sidon, returned from beyond the Jordan, and he informs me that a Jewish colony situated not far from El Mzerib (on the caravan route from Damascus to Mekka) was recently attacked by predatory Bedouin tribes. The settlers were all driven away, their gardens and crops destroyed. Even a road built by the Jews to connect their frontier colony with older ones in Galilee west of the river, was at least partially obliterated. Taxes are more oppressive than ever, officials are corrupt, and prohibitive measures regarding immigration are still in force, although inadequate.

I think, however, I am justified in saying that the prospects are brighter than ever for the Jews in Palestine and for Palestine itself. European influence has obtained a foothold in the country, and the tide of modern ideas cannot be long debarred.

Only four or five weeks ago, an English company announced its determination to build a broad-gage railway from the sea at Haifa through the very heart of Samaria and Galilee to Damascus and on to Bagdad, and active operations have already commenced.

In connection with the development of Palestine, I quote the following from an article by the Vienna correspondent of The London Times, November 25, 1898:

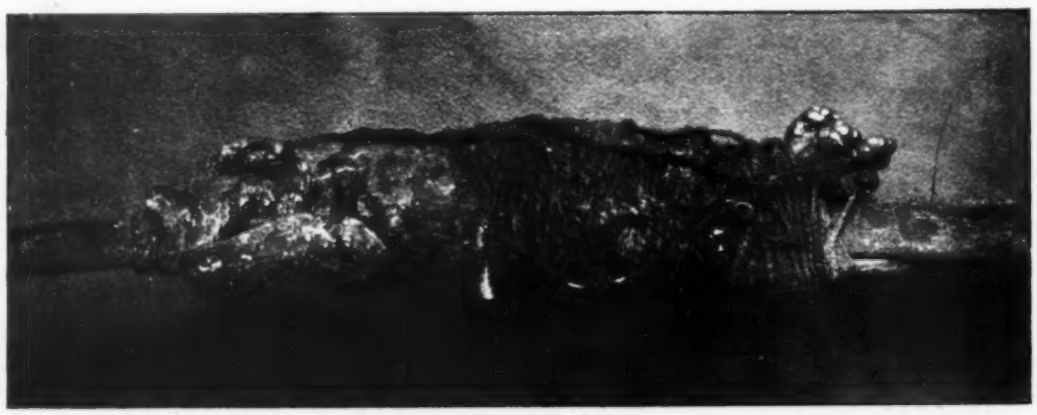
"The following particulars are taken from an interesting official account of the commercial situation in Palestine. A steamship service calling regularly at Gaza would suffice for the moment to open up the extensive hinterland of that port, the population of which may be estimated at 80,000. This would immediately revive the lively intercourse which prevailed in ancient times, as well as in the middle ages, between Gaza and Egpyt. Moreover, Gaza would appear to be the natural terminus of a railway which, passing via Ma-an, Kerak, Madaba, and Es-Salt, would form a junction at Mzerib with the existing Hauran line. This would reopen both to civilization and colonization the ancient cultivated territory east of the Jordan, in which the ruins of innumerable towns prove that it was at one time thickly populated. The newly founded German Oriental Company (Deutsche Orientgesellschaft) will probably devote increased attention to the colonization of Palestine. It will be perfectly justified in doing so, as there are few places on the surface of the globe which offer such rich reward for comparatively slight labor. In those districts there are no immense primeval forests to be felled and uprooted, no constant struggle against hostile aborigines, no rapacious animals, and no malignant diseases. It has a mild and, on the whole, healthy climate. The soil is of inexhaustible fertility, and there is a sufficient water supply. The natives are peaceably disposed, and even the Bedouins on the frontier have, through their long contact with the settled population, become more tractable and friendly."—G. Bie Ravndal, U. S. Consul, Beirut, Dec. 1, 1898.

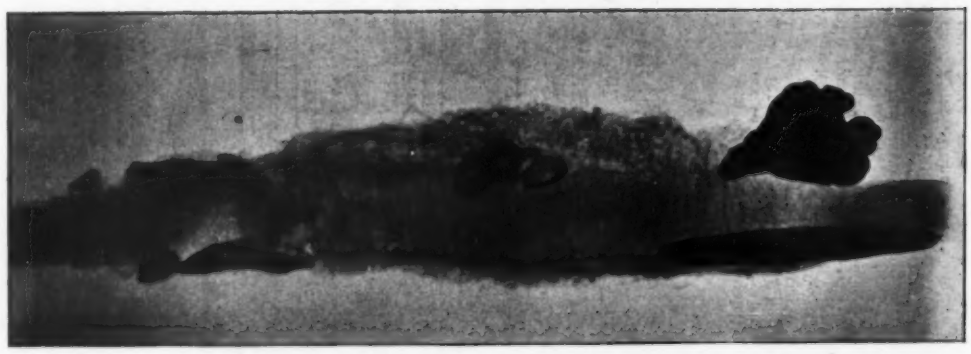
AN ARCHÆOLOGICAL APPLICATION OF THE ROENTGEN RAYS.

By STEWART CULIN.

SHORTLY after the announcement of Dr. Roentgen's discovery the writer, in common, doubtless, with other observers, foresaw the possible value of the new rays in examining the internal construction of valuable museum specimens, and upon the establishment of suitable apparatus in the Pepper Clinical Laboratory by Dr. Charles Lester Leonard, obtained his co-operation in an endeavor to secure a practical application of value in archæological work. Among other experiments, Dr. Leonard (May, 1897) made a successful radiograph of a mummy excavated by Dr. Max Uhle at Pachacamac, in Peru. The closely wrapped bundle, which had not been opened, was shown to contain the skeleton of a child having a string of stone or shell beads about its neck. Another radiograph of a desiccated human foot with an attached leather sandal gave promise of the utility of such pictures in the examination of similar skeletal remains.

More recently, Mr. Cushing having expressed the opinion to the writer that a piece of turquoise, explained by him as the heart of a fetish bird, was concealed beneath the heavy wrapping of brown yarn that binds the finger loops of the prehistoric throwing stick from Mañas Cañon, Colorado, in the University Museum, it occurred to the writer that the verification of this conjecture might be secured with Dr. Leonard's aid. Photographs of the wrapping, with corresponding radiographs made by Dr. Leonard, are shown in Figs. 1 and 2. It will be seen that four stone beads, presumably of turquoise, are revealed, as Mr. Cushing had indicated. I may add that the extreme fragility of the wrapping is such as to render an examination by other means impossible without serious injury to this valuable object.—From the Bulletin of the Free Museum of Science and Art, University of Pennsylvania.





FIGS. 1 AND 2.—FINGER LOOPS WITH WRAPPING AND FETICHES OF THROWING STICK, FROM MANCOS CAÑON, COLORADO—SIDE VIEW.

MACHINE FOR SATURATING LIQUIDS WITH CARBONIC ACID.

GASEOUS beverages have an agreeable taste which is pleasing to a large number of consumers, and which, in a certain measure, contributes toward quenching thirst. Seltzer water offers the most widely known type of these. Recently we have had an opportunity of seeing a machine that permits of saturating all kinds of liquids in bottles much more effectually than was done by the old process.

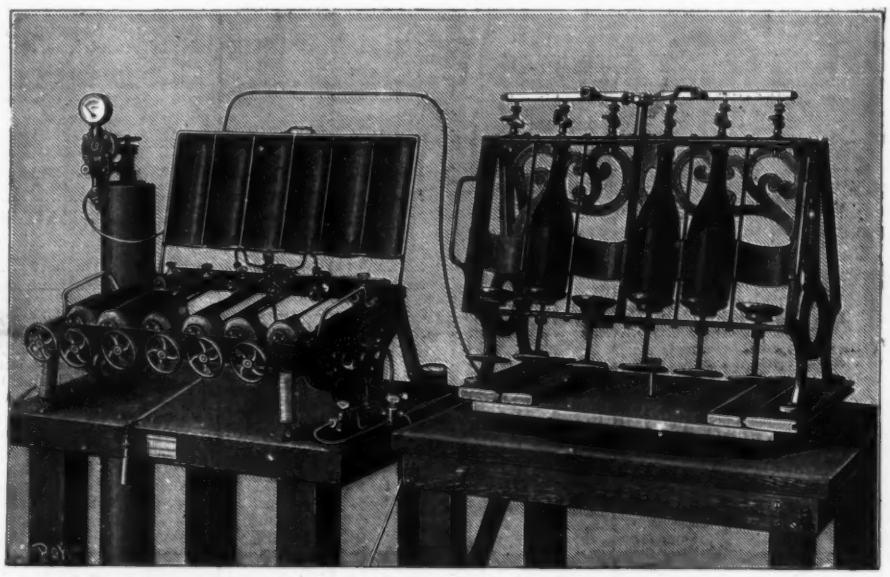
The principal arrangements of this apparatus, which was invented by M. B. Meyer, a manufacturing chemist, may be seen in the accompanying figure. To the left there is an ordinary cylinder containing 175 cubic feet of carbonic acid at a pressure of about 75 pounds to the square inch.

Upon tables alongside of the cylinder are arranged apparatus for holding the bottles of liquid to be charged with the gas, each bottle being placed upon a support which is moved by means of a screw. The neck of the bottle is connected with a tube that may be seen at the upper part. This tube, which is provided with a cock, is itself connected with a horizontal conduit to which is joined the carbonic acid tube.

It suffices to put the bottle in place, and to fix it firmly by revolving the screw, and then to open the cock and allow the gas to pass, in order to convert a bottle of white wine into imitation champagne in two minutes and a half.—For the above particulars and the engraving we are indebted to La Nature.

THE EFFECT OF WEATHER ON EVERY-DAY LIFE.*

SOME time since, a distinguished member of the Cotton Exchange asked my assistance to solve a problem connected with the variation of prices in "futures." He remarked that these prices varied almost from hour to hour without any apparent cause, such as a knowledge of the state of the crop or of the condition of the American market, which would explain these fluctations. He was tempted to look for a subjective cause, and thought it might be found in the state of the weather exercising a powerful but unrecognized influence on the dispositions of purchasers and speculators, inducing them to buy or sell as they were alternately swayed by hopefulness or despondency. I was therefore invited to compare the movement of the cotton market with the variations in the weather, with the view of detecting the hidden relation, and was further stimulated to exertion by the assurance that if the origin of the fluctuation could be discovered, "wealth beyond the dreams of avarice" would be at my command. Unhappily I failed to trace in the fickle weather the hidden springs that underlie the motives of speculators; and that fortune is still to be made by some one, possessed it may be of greater ingenuity or greater application, and to such an one I present the idea without hope of reward or acknowledgment.



APPARATUS FOR CHARGING LIQUIDS WITH CARBONIC ACID.

Mr. Dexter's book reminded me of this experience, for he, too, has apparently embarked on an inquiry as difficult, but with a motive more noble, and let us hope with a reward more certain. Mr. Dexter wishes to trace the influence of weather on human conduct in general, and to see how far man's emotional state is affected by meteorological conditions. His reward is the attainment of a degree of Doctor of Philosophy, and the inquiry which he has instituted has apparently been undertaken with a view to meet the requirements of the authorities of Columbia University. One may sincerely hope that Mr. Dexter will have his ambition gratified, for to say that he has not spared himself in the labor of the inquiry is to say little. What is much more to the purpose, he has not spared others. Teachers and superintendents of schools, wardens of prisons, superintendents of asylums for the insane, officials of the Weather Bureau and many others have been laid under contribution, by having submitted to them a "questionnaire" to completely satisfy whose interrogations involved not a little labor. Apart from the inconvenience which such a process might cause individuals, we doubt whether the plan adopted is the most trustworthy that could be found. Personal influence rather than climatic conditions is likely to introduce a systematic error into the final result. It is open to question whether the authorities consulted have satisfactorily eliminated the effect of weather from their own systems and mental states. The power of punishment rests with the authorities who have been consulted, and it may happen that those under their care are the victims of an irritability, engendered in the supervisors from causes with which the weather has absolutely no concern. To judge therefore mainly by the infliction of punishments seems of rather doubtful wisdom. This obvious objection has, of course, not escaped the author, and in one place he certainly recognizes that the emotional state of the teacher is a not unimportant factor in the result. Indeed, he says, it may be the teacher we are studying more largely even than the pupil. The frankness with which this admission is made is more to be approved than is the reasoning by which it is set aside.

And now we are tempted to record a fact of which Mr. Dexter is entitled to make the fullest use. The temperature is 78°, the sky is cloudy, the wind is east, the velocity about three miles an hour, and under these conditions we find it much easier to present the facts at which Mr. Dexter has arrived than to criticise his results or carp at his methods. We notice that the author has studied, grouped, and commented on no less than fourteen classes of empirical data, embracing more than a quarter of a million separate facts. These, fortunately, can be grouped under fewer heads than the elaborate method pursued by the author admitted, and we hope we shall do him no injustice by the curtailment. First we have the registration and the behavior of children in public schools (which we should probably call Board Schools in England) in New York city and at Denver, Colorado, two very widely different climates it will be remarked. Then we have a large amount of information drawn from police reports, which include assault and battery, discipline in penitentiaries, arrests for insanity and reported suicides. To these are added a few more or less fancy matters, in which the numbers involved are necessarily small, such as the clerical errors discovered in the records of certain of the national banks in New York city, maximum strength tests in gymnasia, and lastly "a study in discrimination carried on in the Psychological Laboratory of Columbia University." The discussion, it will be seen, is very wide, and one fact that will strike the reader prominently when he considers the variety of occupations into which the author has thought it judicious to push his investigations is the length to which this kind of inquiry can be carried when once we are bound hand and foot by the demon of statistics. Possibly the weather has no more to do with a clerk's mistakes than has the quantity or the quality of his supper the night before, but given a nicely ruled sheet of paper, and a system of rectangular co ordinates, it is impossible to forego the delight of plotting results to a scale. This is a harmless amusement; but when we begin to draw conclusions and to build theories, we may go as hopelessly astray as did the famous witness who connected the high tides with the building of a steeple. The author endeavors to meet any criticism of this nature in a passage which we may quote at length, to serve both as an example of his style of writing and his method of argument:

"The meteorological conditions are the essential causes of certain general physiological or mental states, some of which seem to be fertile fields for the action of immediate causes which are, from the standpoint of this problem, accidental. To be concrete, on a certain morning Johnny could not have what he wanted for breakfast, and went to school with the sulks, with a consequent disastrous effect upon his deportment. Most certainly the disappointment at home had a causal relation to his demerit, and no excuse from the weather is sought. But if we take the record of 200 Johnnies for 600 different days, and find that on certain days more of them are out of sorts than on other days, we look for a constant condition which might be considered in some way the cause. We cannot suppose that bad breakfasts or whippings or the disappointments common to child life would bear this constant relation, so look for it elsewhere. Wherever found it must be considered valid. But it must be some factor which would be a part of the environment of all the children similarly affected. We have sought it in the varying conditions of weather, with what success is shown by the curves which form the basis of our discussion."

These curves or diagrams are not so conclusive as the author seems to think. We have no proof that a legitimate application of the calculus of probabilities has been attempted. We cannot estimate the amount of variation exhibited by particular instances from the general interpolatory curve. In a word, we cannot understand how the numerous observations have been combined, so that the unavoidable irregular errors have the least possible effect on the result. Further, these diagrams, or at least some of them, present another difficulty. To take the first figure, which exhibits the effect of weather on the deportment, the class and mechanical work of boys and of girls in schools of various towns, and of boys and girls combined, in Colorado. The abscissa line is divided into eight sections of equal length defined by the weather conditions—hot, cold, wind, calm, storm, muggy, cloud and clear. Evidently there is no connection between the several parts—no regular progression in such an abscissa line. We cannot see, therefore, any reason for joining the several points, of which five out of eight are practically zero. But taking the author's interpretation as it stands, which for reasons already given we are quite prepared to do, this is what we learn.

In climates similar to those of New York, deportment and work are considered to be at their best on cold, calm, clear days, irrespective of sex, and at their worst on "muggy" days. In Colorado, calmness of the atmosphere produces a desirable effect on the condition of the pupils, wind exercises the most deplorable influence. Deportment, which apparently plays a great part in these schools, a fact which should rejoice the shade of the late Mr. Turveydrop, is affected by weather conditions, more in the case of boys than girls. This fact is explained by one teacher on the ground that boys are under less disciplinary control than girls. Another adds that girls "are greater adepts, not only at restraining impulses to do mischief, but also in concealing all evidences of it when it is in progress. This may be due to a greater horror on their part of an open reprimand." The cogency of this argument is not manifest, because the consequences of detection are likely to be visited on the boys with greater asperity than is covered by the term "open reprimand." The knowledge that acute punishment can and will follow conviction, should act as a deterrent and suggest methods of concealment that defy the penetration of the teacher.

When we come to discuss the behavior of children of older growth, we still find the weather capable of exercising a baneful influence on their conduct and self-control, as illustrated by the number of suicides, assaults, and the perpetration of grave crimes. With regard to the morbid tendency disclosed in the mental state that produces the first of these misdemeanors, the author confirms the remark of Morselli and of others, who have considered the statistics of suicide, that an undue proportion take place in May and the spring and summer months of the year. This fact, which is contrary to the commonly received opinion, Mr. Dexter explains as arising not merely from a depleted vitality, produced by the exhausting influence of the cold of winter, but also by the "conscious or unconscious contrast of the recognized low condition of vitality with the exuberance of energy and life in the rejuvenated nature about, making one that is weak feel that the struggle against the resistance to life and progress, in competition with a world so virile, is hopeless." This remark is perhaps more ingenious than convincing, but if any considerable space of time is supposed to elapse between the contemplation and the completion of the act, it seems useless to tabulate the number of suicides with the height of the barometer and the humidity of the atmosphere, quantities that are continually varying.

It is of interest to notice that the number of assaults increases pretty uniformly with the temperature, or it would be more correct to say with an excess of temperature. Given a hot day in the spring or autumn, and our pugnacity rises in an alarming manner, though in the hot days of summer this quarrelsome mood is not so aggressive. The author concludes from the arrangement of his facts that the effects of heat up to a certain limit are vitalizing in their tendency, while at the same time irritating, but above that limit, heat is so devitalizing in its effects as to leave hardly energy enough to carry on a fight. Sad to relate, the effect of heat upon ladies is greater than on men; and this is shown not only by an increased desire to fight, but also by evident mental unbalancing. Whether one is the consequence of the other, or whether both are to be traced to the greater sensitiveness of women to weather conditions, is too thorny a subject for masculine debate. But the tales that come from penitentiaries and from those who have charge of the insane, alike testify to the irritating effects of increased temperature. In this connection the author thinks that a study of the record of profanity might yield interesting results, but unfortunately he adds "inclination alone will at least get no one into the police court," so that numerical data are wanting to discuss this phase of the weakness of human nature. It would probably be found that the curve would not greatly differ from that of assault, and it would certainly be comforting if we could shift the responsibility of our deviations from rectitude to such an impersonal agent as the weather. In our own ignorance we were rather tempted to attribute these lapses from good conduct to too free an indulgence in alcoholic beverages in the warm weather, but the author with far greater familiarity with the subject traces them to a much deeper source, to be found possibly "in the depletion of the cell structure," or "in acceleration of the oxidizing processes of life," expressions which we can only hope are as accurate as they are sonorous.

It is no new question to seek the effect of weather upon the moods and impulses of the population, but Mr. Dexter has tapped a new source of inquiry when he asks what are the meteorological conditions which induce clerks in banks, and we presume computers in general, to make mistakes in their work, and to offer up incorrect answers. When the barometer is low, let us forswear computations, but if the humidity be at the same time small, it would be positively immoral to attempt to add up a column of figures. The author explains this by the fact that "the intellectual balance is more disturbed by the increased electrical potential than is the emotional." We are afraid to discuss this proposition, more especially as we have overstepped the limits of space, but we must find room to

* "Conduct and the Weather: an inductive study of the mental effects of definite meteorological conditions." By Edwin Grant Dexter, A.M. (New York and London: The Macmillan Co. Psychological Review Memoir.)

say that we respect the evident trouble and care which the author has taken in compiling his results, and to ask his pardon if our remarks have appeared too flippant, when applied to a work which he has taken very seriously. Some of his inquiries are not yet complete, but we hope that he will continue them to the end, and leave his results in such a form that a more rigorous discussion may be possible. By "rigorous" is merely meant on recognized mathematical principles, in which one can see easily the relative "weight" which is to be attached to the separate deductions, and the "probable error" that accompanies each.

—W. E. P. in Nature.

TRADE NOTES AND RECEIPTS.

Decolorization of Oils and Fats.—Many oils contain ferric oleate, which causes a dark reddish brown color. Same is best removed by treatment of the oil or fat, dissolved in petroleum by means of sodium sulphide. Ferrous sulphide precipitates, which can be separated out by filtering through a bag moistened with petroleum. By far too little consideration has so far been given to the ferric oleate in most oils and greases.—Seifenfabrikant.

Violet Stains for Wood.—Violet colorings are now almost exclusively produced with tar dyestuffs. According to the purpose desired, alizarine red or methyl-violet is employed.

A deep violet is obtained by mixtures of indigo substitute with red carmine (i. e., commercial oxidized red dye-wood extract) in varying proportions. Thus, a mixture of 15 grammes of artificial indigo and 10 grammes of red carmine in 250 grammes of water and 5 grammes of acetic acid produces very handsome violet tones, which can be rendered much more brilliant by adding 1 to 2 per cent. of methyl-violet (of the weight of the indigo substitute and the red carmine).

Violet after Stubenrauch.—Place the wood in a bath or paint it with a solution of olive oil 1 part and calcined soda 1 part in 10 parts of boiling water and coat it next with fuchsine solution, or better still, with a solution of 1 part of methyl-violet in 25 parts of alcohol.

Instead of the methyl-violet, Victoria or Parma violet may be used. By diluting the dye solution or adding more alcohol it is entirely in one's power to impart to the white wood a pale or dark violet color in the most varying gradations and shades, and there is perhaps hardly another wood dye which equals the above as regards luster and brilliancy.

Dull Violet Wood Dyes.—The vivid and fiery violet tones are not as a rule very popular, especially not for furniture. More delicate and duller shades of violet are produced with alizarine or with benzo-purpurine. Here are three samples:

Dull Reddish Violet.—Solutions of alizarine red or aluminium acetate for pear.

Dull Bluish Violet.—Solutions of alizarine red and blue vitriol for birch.

Medium Dull Violet.—Solution of benzo-purpurine 4° Bé. for birch.—Wiener Möbelhalle.

Varnish for Straw Hats, etc.—It is self-understood that a straw hat varnish whose sale will be in the hands of druggists, paint dealers, milliners, etc., and which may be used by the public, must dry in a few minutes and form a firm, pliant and elastic cover, though it need not exhibit a high luster. Hence, it must be a spirit varnish, whose resinous constituents must be composed accordingly, and which can only be colored with pigments soluble in alcohol, the coal tar colors being best adapted for this purpose.

In general it is advisable for the manufacturer of straw hat varnish to prepare two or three colorless stock varnishes which he can dye ad libitum. This requires some experience. Shellac is the indispensable gum for every spirit varnish. Since it cannot, owing to its brown color, furnish a white or pale varnish, it is suitable for dark colored varnish. A good stock varnish for black, brown, dark green, deep blue and similar tones is obtained from shellac 900 grammes, soft Manila copal 225 grammes, sandarac 225 grammes, castor oil 5 grammes, and methylic alcohol; if necessary, the sandarac's place may be taken by resin. To produce colored varnishes from this, the respective alcohol-soluble aniline color need only be added. Especially ivory black, spirit blue, Bismarck brown, aniline yellow, brilliant green, safranine, crystal scarlet, etc., are eligible for this purpose, and by their mixture the most varying tints can be produced. Only the purest and best grades of these colors should be used and too plentiful an admixture should be avoided. The production of straw hat varnishes is effected entirely by the cold process, only a careful intermixing, a slow digesting to complete solution (perhaps filtration) and stirring from time to time being necessary. To the above stock varnish add for black: 55 grammes of spirit-soluble ivory black per 9 liters of varnish. The shade may be varied beautifully by a slight addition of spirit blue or malachite green. Olive brown: Brilliant green, 15 grammes; Bismarck brown, R, 55 grammes; spirit blue, 8 grammes. Olive green: Brilliant green, 28 grammes; Bismarck brown, R, 28 grammes. Nut brown: Bismarck brown, R, 55 grammes; nigrosine, 15 grammes. Mahogany brown: Bismarck brown, 28 grammes; the color may be rendered deeper by a little nigrosine.

A white stock varnish suitable for the preparation of light colored straw hat varnish is a mixture of sandarac 1350 grammes, elemi-resin 450 grammes, pine resin 450 grammes, castor oil 110 grammes, methylic alcohol 9 liters. Preparation same as above.

For tinting take, per 9 liters of this varnish, for Golden yellow: Chrysoidine 55 grammes and aniline yellow 55 grammes. Pale green: Brilliant green 55 grammes and aniline yellow 7 grammes. Blue: Spirit blue, 55 grammes. Deep blue: Spirit blue 55 grammes and induline 55 grammes. To obtain other blue tones, the proportion of these two substances may be varied. Peacock blue: Spirit blue 5·5 grammes, induline 28 grammes and a little brilliant green. This color can also be obtained with the dark stock varnish by spirit blue 55 grammes and induline 28 grammes. Violet: Methyl-violet, 3 B, 28 grammes. Crimson: Safranine 55 grammes. Chestnut brown: Safranine 55 grammes and induline 15 grammes.

In a similar manner any spirit-soluble aniline colors can be employed for dyeing spirit varnishes; 28-55 grammes may be taken as the average proportion.—Farben Zeitung.

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